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Part III

A Study of the Economic Impact on the Steel Industry of the Costs of Meeting Federal Air and Water Pollution Abatement Requirements

COUNCIL ON ENVIRONMENTAL QUALITY

Washington, D. C.

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July 27, 1972

Mr. Eric Zausner
Council on Environmental Quality
722 Jackson Place, N. W.
Washington, D. C.

Dear Mr. Zausner:

We are pleased to submit Part III of our final report on the Economic Impact of Federal Air and Water Pollution Abatement Requirements on the Steel Industry. This volume supersedes Part II, Chapter VI and Part II of our original report dated December 1, 1971.

1. STEEL DEMAND AND PROBABLE SHIPMENTS 1972-1976

Demand for steel measured by domestic steel consumption should recover from depressed 1970-1971 levels, providing that economic recovery from the recession experienced during those years proceeds as anticipated. Assuming sustained economic growth of at least 4% per year for the period 1972-1976, steel consumption should fall into 120-130 million ton range by 1976.

Net steel shipments by producers are determined by the level of steel exports and imports as well as domestic consumption. Depending on the level of demand, domestic steel production capacity can also be a

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significant factor. Capacity limitations aside, potential net steel shipments, considering particularly domestic consumption and import penetration should fall within the 106-113 million ton per year range by 1976. Production capacity as a factor limiting potential growth in shipments is discussed below.

2. DOMESTIC STEEL PRODUCTION CAPACITY

Complete and reliable data regarding domestic steel capacity are not available. On the basis of partial information from several published sources and unpublished information made available by the American Iron and Steel Institute estimates of current usable domestic raw steel production capacity have been made. Raw steel capacity is estimated to be in the 155-165 million ton range. After allowing for processing losses and reserve capacity required to meet peak demand loads as well as product mix changes, sustainable steel shipment capacity is estimated to be between 98 million tons and 105 million tons per year.

To develop the capacity to ship 106-113 million tons by 1976, total domestic steel production capacity (allowing for reserve capacity requirements) may have to be expanded by zero to 16 million tons depending on the actual level of current capacity and anticipated 1976 demand.

3. STEEL INDUSTRY CAPITAL EXPENDITURE REQUIREMENTS 1972-1976

Excluding expenditures for pollution abatement, steel industry capital expenditures fall into two categories:

- Expenditures to modernize and replace existing plant and equipment
- Expenditures to increase capacity to meet anticipated demand

Required capital expenditures to modernize and replace existing plant and equipment during the period 1972-1976 are estimated to total $6.85 billion (1971 dollars). Expenditures needed to increase capacity, depending on current capacity and future demand, may range from zero to as much as $6.53 billion over the same period.

4. POLLUTION ABATEMENT COSTS

Air and water pollution abatement cost estimates were supplied by the Council. Because of uncertainties as to costs, the estimates provided were stated in terms of ranges as follows:

- Capital investment requirements were estimated to range from $2.4 - $3.5 billion for the period 1972-1976
- Annual costs, including operating costs, depreciation and interest, were estimated to range from $760 million to $875 million by 1976

Estimated capital expenditure requirements were used for analysis without adjustment. Estimated annual costs as shown were adjusted to conform with current projections of debt required to finance pollution abatement and anticipated interest costs. For purposes of analysis, a 7% investment credit for capital expenditures was assumed.

In addition to capital expenditures for pollution abatement itself, it is also possible that pollution abatement requirements may result in accelerated capital expenditures to replace existing plant and equipment which cannot be economically cleaned up due to age and/or physical condition. A steel industry source has estimated such expenditures to be approximately $2.75 billion, principally to replace obsolescent blast furnaces, sintering facilities, and open hearth furnaces. While it may be preferable to replace a facility rather than to simply clean it up, it may also be preferable to clean up a facility rather than shutting it down, assuming funds for replacement are limited due to other capital demands. It may also be possible for steel producers to reallocate funds for accelerated replacement of blast furnaces, sintering mills and open hearth furnaces which would normally have been used for other facilities replacement or modernization projects over the short term. Because of these factors, it is not possible to accurately assess the true burden of accelerated capital expenditures over the relatively short term (1972-1976). As a result, economic impact has been evaluated assuming both zero net accelerated capital expenditure requirements and net accelerated capital expenditure requirements of $2.75 billion.

5. THE IMPACT OF POLLUTION ABATEMENT COSTS ON INDUSTRY GROWTH AND PROFITS

To provide a base for analysis, detailed baseline projections of steel industry profits and cash flow were prepared for the period 1972-1976. Separate projections were prepared assuming shipment levels by 1976 of 100, 106, and 113 million tons. Pollution abatement capital and annual costs were evaluated against the alternative baseline projections to measure potential impact. On the basis of this analysis, conclusions are as follows:

- Steel price increases of approximately 4.3% per year for the period 1973-1976 will be required to cover all steel industry cost increases including pollution abatement annual costs. Such price increases, while higher than Price Commission guidelines, should prove feasible from a market point of view.

- The ability of the steel industry to maintain growth and absorb pollution abatement capital expenditures depends on five major factors characterized by uncertainty:

  - Pollution abatement capital requirements
  - Current industry production capacity
  - The cost of additional capacity
  - Reserve capacity required
  - Accelerated capital expenditure requirements

- Considering the effects of the above uncertainties the following conclusions regarding growth appear warranted:

  - A minimum growth in steel industry shipments to 100 million tons by 1976 can reasonably be

expected. To fund pollution abatement capital expenditures, steel producers will be required to do the following:

. Obtain new borrowings at a rate which will keep the industry at or near its feasible borrowing limits

. Apply all available internal funds to pollution abatement after provision for dividends at 1971 dollar levels, normal capital expenditures, and working capital

- Subject to the potential burden of accelerated capital expenditures, it appears that financing pollution abatement capital expenditures should in the main be possible, given that industry profit performance is as projected.

- Growth to a 1976 shipment level of 106 million tons in the face of pollution abatement capital expenditures is dependent on the behavior of the five major variables identified above. Funds needed for pollution abatement capital expenditures, in addition to funds available internally and through borrowing, could range from zero to more than $2 billion, assuming that dividends remain at 1971 levels. Significant dividend reductions to obtain additional funds could result in impaired producer borrowing capacity.

- Growth to 1976 shipment levels of 113 million tons may be ruled out on the basis of the inability of the industry to finance the necessary investment. In this case, however, pollution abatement costs are not the controlling factor as expansion of capacity to the level required to insure shipment of 113 million tons would not take place even if pollution abatement was not a factor.

6. REGIONAL EMPLOYMENT IMPACTS

Although it is unlikely that any decrease in overall steel industry employment would take place directly as a result of pollution abatement requirements, it is possible that local employment displacement will be experienced unless outside assistance is provided in some form. The pattern of such potential local displacement cannot clearly be defined within the scope of this study.

Very truly yours,

Booz · Allen

Public Administration Services, Inc.

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I. STEEL DEMAND AND PROBABLE SHIPMENTS 1972-1976

The purpose of this chapter is to provide estimates of the probable level of domestic steel demand and mill production during the period 1972-1976.

1. INTRODUCTION

Forecasts of steel demand and output are presented as a range of likely alternatives based on varying assumptions as to the behavior underlying factors.

The level of steel shipments in a given year depends on three basic elements:

- The level of domestic demand for steel plus some small allowance for exports
- The level of steel imports
- The capacity of domestic mills to produce raw steel and convert it to the product mix desired by the market.

The behavior of these elements will be controlled by distinct sets of factors which, especially over the short term, are largely independent:

- Domestic demand for steel will reflect essentially the level and rate of growth of the overall national economy and its changing composition as well as technological developments affecting steel use by specific industries.

- In theory, the level of steel imports depends on the price, quality, and delivery schedules offered by foreign producers. Terms offered by foreign producers depend on:

  - Costs of air and water pollution abatement abroad
  - Costs of production and transportation
  - Demand for steel in foreign markets
  - The relative profitability of selling in the U.S. versus foreign markets

- In practice, many other factors can influence the level of steel imports. The more significant are:

  - Mandatory or voluntary import quotas
  - Political and economic objectives and strategies of foreign countries and producers
  - Competitive policies of domestic producers
  - Preference of some domestic consumers for maintaining close ties with domestic producers
  - Periodic domestic strike threats
  - The level of domestic capacity versus demand

Domestic steel capacity is not systematically defined or reported, and capacity estimates vary widely. Because of its importance to this analysis, the subject of capacity will be treated separately in Chapter II.

The following sections of this chapter contain a detailed analysis of steel demand and estimates of steel mill shipments as affected by import penetration of the domestic market.

2. HISTORICAL TRENDS IN STEEL CONSUMPTION

The initial step taken in forecasting steel demand was to analyze historical trends. Several methods of analysis were examined:

- The secular trend of domestic steel consumption expressed as a logarithmic time series for the post World War II or Korean War period
- Steel consumption as a function of basic economic parameters:
  - Real Gross National Product (GNP)
  - The vigor of the economy in a given period of which unemployment rates are a rough but convenient measure
  - Secular trends in the relation of steel demand to overall economic activity
- Steel consumption as a function of activity in major steel-using industries, principally:
  - Automotive
  - Producers' durables
  - Consumer's durables
  - Construction

Some comments about each method are appropriate:

- The secular trend derived from a simple time series cannot, by its nature, measure the influence of underlying economic and technological factors on demand. When such factors differ substantially from the average of the years on which the trend has been calculated, actual and predicted consumption will be far apart.

- Sector-by-sector analysis, the third method outlined on the previous page, is theoretically most thorough, but necessary data were not available for this study. In addition, future activity in specific industries is subject to much greater uncertainty than that of the economy as a whole. This method is, however, relied upon by major steel companies in their planning. The details of demand forecasts prepared by individual steel producers have not been made available for competitive reasons; however, a range of forecasts prepared separately by several major producers has been made available and will be presented.

- Given time and resource constraints, the second method outlined above, which relates steel consumption to basic economic parameters, is best for the purpose and nature of this study, and is presented in some detail below.

(1) Time Trend of Steel Consumption

1. Point-to-Point Measurement

One method of measuring the historical trend of steel consumption is to compute the change in consumption between specific years or periods, and express this change in terms of a compound annual rate of growth. The results of such an analysis will be affected by the state of the economy during periods chosen, including factors such as the Korean and Vietnam Wars.

An analysis using this method is summarized on Exhibit I, following this page. For each of the five time periods shown, the average unemployment rate for the

EXHIBIT I

Council on Environmental Quality

GROWTH OF STEEL CONSUMPTION
DURING SELECTED PERIODS

Period	Average Steel Consumption* (Million Tons)	Average Annual Unemployment Rate	Increase in Apparent Consumption (Percent)	# Years	Compounded Annual Increase (Percent)
Case 1					
1947-	54.3	3.9%	-	-	
1971	101.0	5.9%	86.0%	24	2.62%
Case 2					
1947-49	56.9	4.5%	-	-	
1969-71	101.4	4.8%	78.2%	22	2.66%
Case 3					
1954-56	74.0	4.7%	-	-	
1969-71	101.4	4.8%	37.0%	15	2.09%
Case 4					
1954-58	72.3	5.0%	-	-	
1967-71	100.8	4.3%	39.4%	13	2.58%
Case 5					
1959-61	70.6	5.7%	-	-	
1969-71	101.4	4.8%	43.6%	10	3.68%

*Consumption estimates from industry sources include adjustment for inventory change, but do not include any allowance for shipments by some minimills which report raw steel output but not shipments to the American Iron and Steel Institutute (AISI). These shipments are estimated by AISI at 1.8 million tons in 1969 and in 1970. The 1969-71 consumption estimates include an allowance for minimill shipments.

NOTE: The data for 1971 are preliminary

beginning and ending periods is shown as an approximate measure of the prevailing state of the general economy.

Of the five cases presented, the first and the last have little analytical significance:

- The results of the 1947-1971 comparison is consistent with the other cases, however, a single year-to-year analysis is not a sound basis for comparison, especially for an industry as volatile as steel.
- The 1959-1961 to 1969-1971 result is clearly freakish, largely due to the lagging economic growth and high unemployment during both periods.

The remaining three cases fall into a consistent pattern with a growth rate of 2.7% for the entire post-war period and rates for the post-Korean period ranging from 2.1% to 2.6%. The difference between the 3-year and 5-year post-Korean comparisons (Cases 3 and 4) reflects the fact that steel consumption in 1955 and 1956 was at peak levels, unequalled until 1963, partly as a result of very high automobile output following the end of Korean War restrictions. Against this, it must be noted that average unemployment during 1954-1958 was higher than in 1967-1971.

2. Period Measurement

A second approach, developing a logarithmic regression equation measuring the trend of steel consumption growth over time, is technically preferable to the method used above. The growth trend derived, however, depends upon the period chosen. As noted above, a major disturbing factor affecting the entire postwar span, 1947-1971, was the Korean War. While the Vietnamese buildup was also a factor during the 1960's, its impact was gradual and relatively much smaller.

Dr. David R. Dilley, U. S. Steel's economist, has performed a regression analysis for the 1947-1971 period showing an average annual continuous growth rate of 2.32%. We have computed a similar regression for the post-Korean period, 1954-1971, which shows a somewhat more rapid growth rate of 2.65% per year. (Both rates are reasonably consistent with the cruder results shown in 1. above).

Since the trends computed in the above manner do not and are not intended to account for specific economic factors prevailing during a given year or years, as would be expected in many years, there was substantial divergence between the long term trend line of consumption

and actual consumption over the period 1947-1971. The extent of divergence is evident from Exhibit II, following this page.

(2) Steel Concumption Related to Economic Activity

It is clear from the record that steel consumption during any year or period is closely related to the level and vigor of general economic activity. Exhibit III, following Exhibit II, compares steel consumption for the 1947-1971 period with real GNP (1958 prices) and real GNP excluding the services component which represents only a negligable demand for steel. The unemployment rate for each year is also shown.

This comparison appears to indicate the following:

- The ratio of steel consumption to total economic output declined substantially between 1947 and 1958; much of the break occurring between 1957 and 1958 with the onset of the severe recession during the latter year. The decline in the ratio was slightly sharper in comparison with total GNP than when services are excluded.

- Since 1958, the steel-GNP ratio has varied within a fairly narrow range with no clearly discernible secular trend. The pattern for total GNP and for GNP, excluding services, was almost identical.

EXHIBIT II

Council on Environmental Quality

TREND LINE OF STEEL CONSUMPTION
VS. ACTUAL CONSUMPTION 1947-1971
(Millions of Tons)

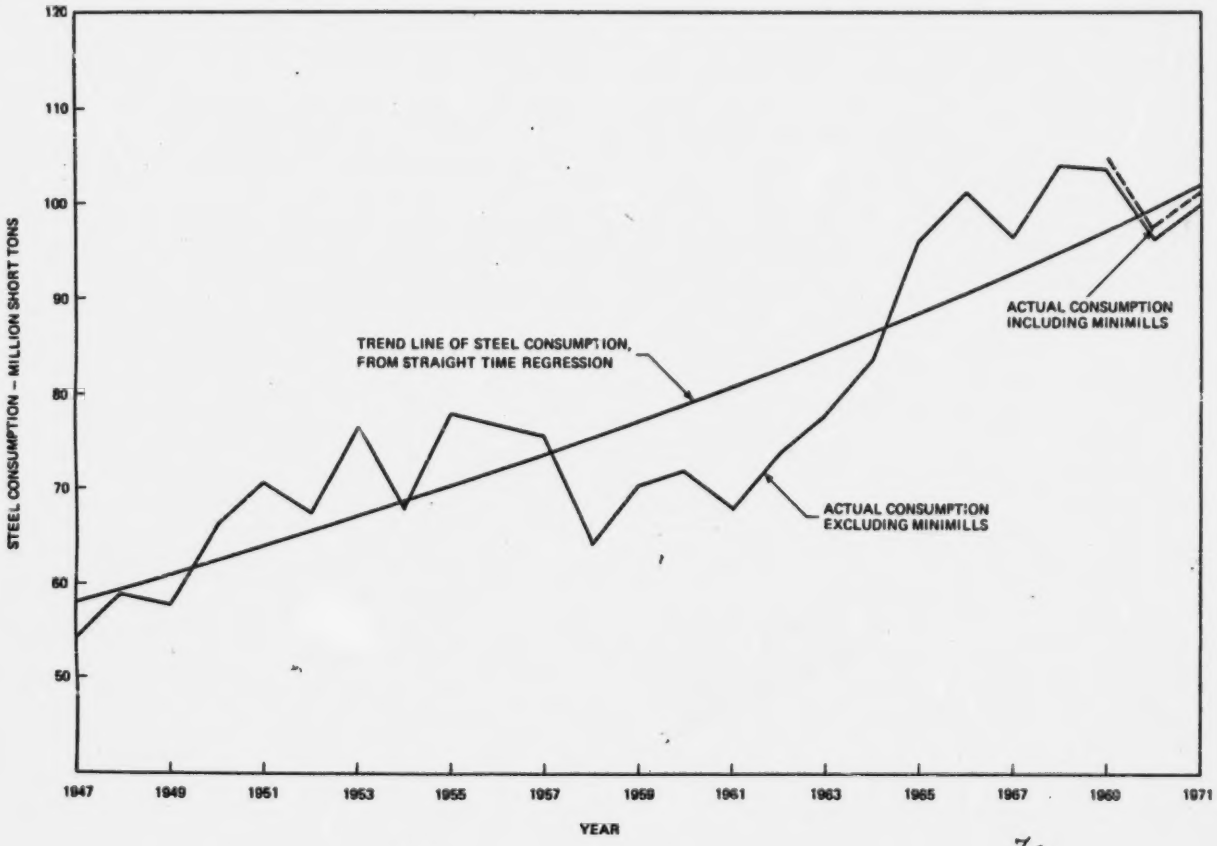

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EXHIBIT III

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STEEL CONSUMPTION, REAL GNP, AND UNEMPLOYMENT, 1947-1971

Year	Steel Consumption (millions of tons)	GNP (Total) Billion 1958 Dollars	GNP Ex-Services Billion 1958 Dollars	Consumption Divided by: Total GNP	Consumption Divided by: GNP Ex-Services	Unemployment Rate %	Consumption Divided by GNP Index Numbers 1958 = 100 Total GNP	Consumption Divided by GNP Index Numbers 1958 = 100 GNP Ex-Services
				(tons per thousand 1958 dollars)				
1947	54.3	309.9	203.4	.0176	.0267	3.9	122	118
1948	58.9	323.7	214.4	.0182	.0274	3.8	127	121
1949	57.6	324.1	211.7	.0178	.0273	5.9	123	121
1950	66.1	355.3	237.8	.0186	.0279	5.3	129	123
1951	70.2	383.4	252.9	.0183	.0277	3.3	127	123
1952	67.3	395.1	258.8	.0170	.0260	3.0	118	115
1953	76.2	412.8	272.5	.0184	.0280	2.9	128	124
1954	67.7	407.0	265.2	.0166	.0255	5.5	115	113
1955	77.7	438.0	290.5	.0178	.0267	4.4	123	118
1956	76.6	446.1	293.1	.0172	.0262	4.1	119	116
1957	75.5	452.5	292.4	.0167	.0258	4.3	116	114
1958	64.1	447.3	283.9	.0144	.0226	6.8	100	100
1959	71.1	475.9	304.7	.0149	.0233	5.5	103	103
1960	72.7	487.7	311.1	.0149	.0234	5.3	103	104
1961	68.0	497.2	313.2	.0137	.0217	6.7	95	96
1962	73.6	529.8	336.1	.0139	.0219	5.5	97	97
1963	77.8	551.0	350.1	.0141	.0222	5.7	98	98
1964	83.5	581.1	370.3	.0144	.0225	5.2	100	100
1965	95.8	617.8	395.9	.0155	.0242	4.5	108	107
1966	100.9	658.1	421.8	.0153	.0239	3.8	106	106
1967	96.3	675.2	426.1	.0143	.0226	3.8	100	100
1968	103.6	707.2	447.2	.0147	.0231	3.6	102	102
1969	105.3(a)	727.1	458.9	.0147	.0232	3.5	99	100
1970	97.8(a)	720.0	446.6	.0136	.0218	4.9	95	97
1971(b)	101.0(a)	739.5	460.6	.0137	.0219	5.9	95	97

(a) Including estimate for minimills
(b) Preliminary

Sources: Steel Consumption from U. S. Steel Corporation, including adjustment for inventory change; GNP and unemployment from 1972 Report of the Council of Economic Advisors.

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- In general, the steel-GNP ratio tended to rise as the economy approached full employment and to fall as unemployment increased. As noted, the ratio fell very sharply during the 1958 recession. It declined again in 1961 as unemployment neared 7%. It then rose steadily to 1965-1966 as the economy recovered and fell again to the 1961 level in 1970 and 1971 as unemployment increased. The relatively high ratios for 1965 and 1966 presumably reflected the initial Vietnamese buildup; real GNP during those years rose $37 billion and $40 billion in 1958 dollars, respectively, whereas economic growth from 1967 to 1969 was considerably slower even though unemployment remained low.

This comparison tends to confirm the close relationship between steel consumption and real GNP over time, with consumption relatively higher during years of vigorous economic growth of which the unemployment ratio is a rough but convenient indicator. (The rate of GNP growth each year would be another index, but would not change the pattern significantly; it would also introduce technical statistical difficulties resulting from auto-correlation.) To measure this relationship quantitatively, we have computed the following regressions:

- Steel consumption as a function of real GNP and time for the entire 1957-1971 period and for the post-Korean span, 1954-1971. The inclusion of time as a parameter was designed to allow for the slow secular decrease of the consumption--GNP ratio.

. Steel consumption as a function of real GNP, time, and unemployment for the 1947-1971 and 1954-1971 periods.

The computed relationships are set forth in the following equation:

1(a) Consumption in millions of tons (C) as a function of GNP in billions of 1958 dollars and time (T); 1947-1971.

$$C = -9.06 - 2.47\,T + 0.236\,GNP$$

(In 1947, T = 1; in 1971, T - 25; in 1976, it would equal 30).

1(b) Same as 1(a) for 1954-1971.

$$C = -20.1 - 4.36\,T + 0.312\,GNP$$

2(a) C as function of GNP, Time, and Unemployment (U), 1947-1971.

$$C = 21.7 - 1.0\,T + 0.158\,GNP - 2.26U$$

2(b) Same as 2(a) for 1954 - 1971.

$$C = 13.2 - 2.56\,T - .221\,GNP - 2.42U$$

The multiple correlations and standard errors for each of these regressions are as follows:

Regression	Correlation (R)	Standard Error (Million Tons)
1a	.970	3.7
1b	.981	2.7
2a	.975	3.9
2b	.985	2.4

In each case, it is evident that the correlation coefficient is very high and the standard error acceptably low. The "T" ratios and Durbin-Watson tests are also within acceptable limits. The best fit is for equation 2(b); consumption as a function of time, GNP, and unemployment for the post-Korean period. For both time periods, the inclusion of the unemployment factor improves the correlation coefficient.* Consequently, we have omitted equations 1(a) and 1(b) from further consideration.

Exhibit IV following this page, compares actual consumption for the entire 1947-1971 period with that calculated from the straight time regression and the equation based on time, GNP, and unemployment. The sharp contrast between these two methods is manifest. The latter equation follows both the trend and magnitude of actual consumption closely. For the 1954-1971 period, an even closer fit would be obtained by using equation 2(b) above, but the differences are quite minor.

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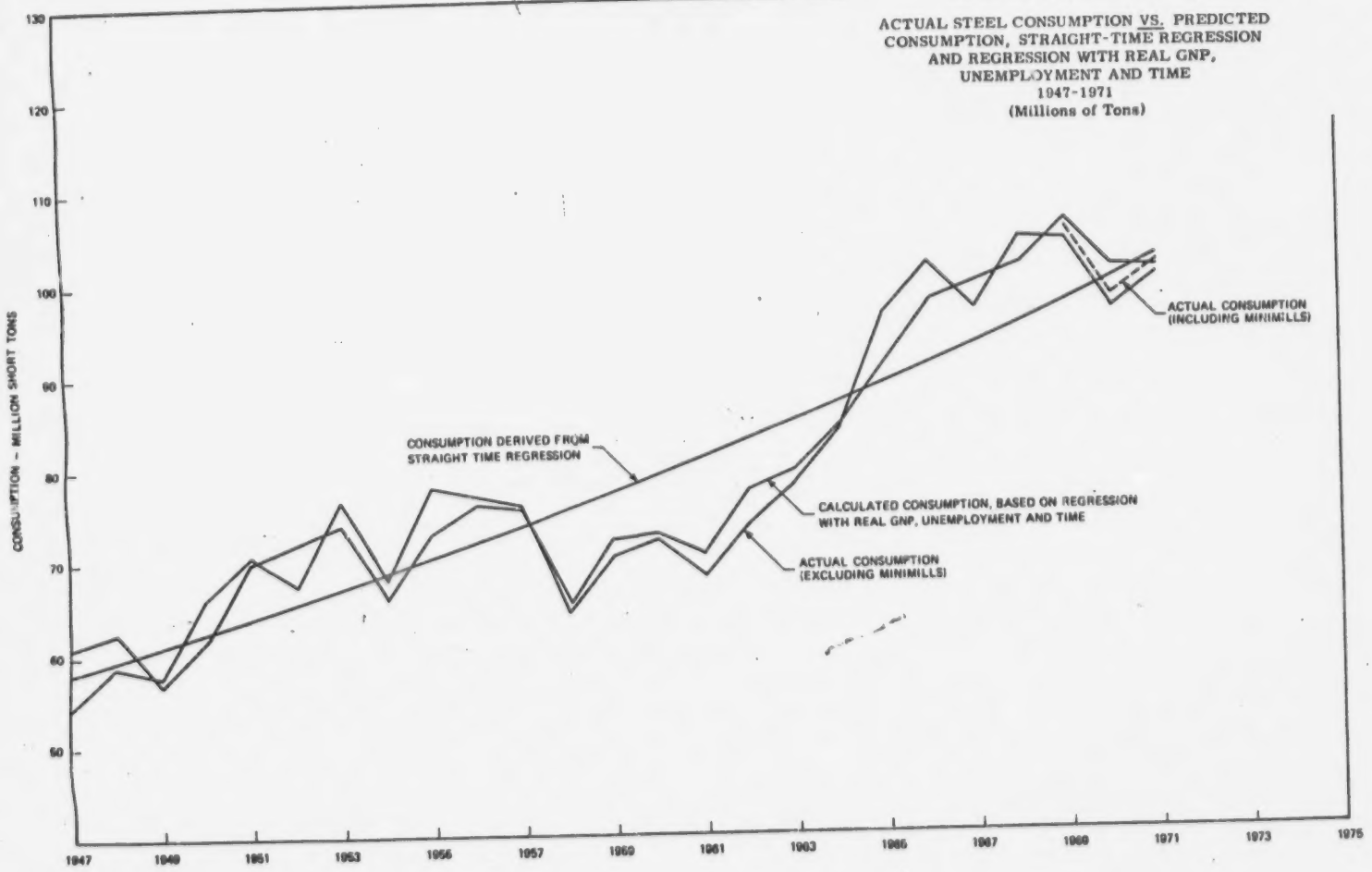
* Another possible method of estimating the relation between the trend of GNP and that of steel consumption is to compare the rates of increase (or decrease) of these variables over defined periods of time. A steel industry source prepared such a study for 1-, 5-, and 10-year intervals for the period 1947-1968. However, the predicted consumption volumes derived from this approach correlate much less closely with actual volumes for the postwar period than the method used here.

EXHIBIT IV

Council on Environmental Quality

ACTUAL STEEL CONSUMPTION VS. PREDICTED CONSUMPTION, STRAIGHT-TIME REGRESSION AND REGRESSION WITH REAL GNP, UNEMPLOYMENT AND TIME
1947-1971
(Millions of Tons)



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10c

(3) Sector Analysis

The third method of assessing historical trends in steel consumption is analysis of consuming sectors. As noted above, this method, which is theoretically most thorough is used by major steel companies in their corporate planning. The American Iron & Steel Institute has made a range of steel demand forecasts to 1976 available for this study. This range represents the high, low, and mean of individual forecasts provided to AISI by eight major steel companies. Since the details underlying these forecasts were not provided for legitimate competitive reasons, there is no basis for evaluating them. However, since they do represent the best estimates of major steel producers prepared on the basis of detailed sector by sector analyses, they should be seriously considered. These estimates are covered in the following section of this chapter.

3. PROJECTIONS OF STEEL CONSUMPTION

As set forth in the preceding section, projections of domestic steel consumption for 1976 may be derived in three ways: (1) the simple extrapolation of past secular time trends; (2) relating steel consumption to projected overall economic activity; (3) projecting sectoral steel demand.

(1) Demand Projected From Secular Time Trends

Although the use of secular time trends is satisfactory for long term projections, it is not intended for use in projecting demand in specific years, nor would it be appropriate when it is assumed that the near term outlook is for rapid economic growth.

For purposes of illustration, however, application of the average continuous growth rate of 2.32% computed by Dr. Dilley to the 1947-1971 trend line would indicate steel consumption of approximately 114 million tons by 1976. At the higher growth rate of 2.6% for the post Korean years, the corresponding forecast for 1976 would be about 118 million tons.

(2) Projections of Steel Consumption Related to General Economic Trends

Past levels of steel consumption for any given years are, of course, more closely related to basic economic parameters applicable to those years than to the long term trend line. This strongly implies, but does not necessarily assure, that economic parameter behavior is also a more reliable basis for forecasting future consumption provided, of course, that the forecast of general economic activity used is accurate.

For an extended period of years, indeed, the direct extrapolation of the past secular trend may be as reasonable a way as any of arriving at such projections, assuming that appropriate allowance is made for foreseeable changes in technology and the structure of the economy. It does not follow, however, that this is also true of the shorter time span of four or five years which is the concern of this study.

The essential point is that, while the broad upswings, downswings, and relatively flat periods that have characterized our post-war economy may be expected to average out over several decades, this is distinctly not true of the shorter run. Since Korea, for example, there was a recession in 1954; recovery for the next three years; a downswing in 1958 and 1959; slow recovery in 1960 and 1961; a sharp acceleration to 1965-1966; and flat spotty progress to the latter part of 1971 with unemployment at its highest levels for a decade. There is general consensus, however, as evidenced by recent forecasts prepared by the Council of Economic Advisors, the National Planning Association, the Conference Board, and others that we are now entering a period of recovery which the government will make every effort to sustain through 1976.

The key element in this recovery is the unemployment level, the reduction of which is universally recognized as a political goal. This implies the continued pursuit of strongly expansive fiscal and monetary policies, at least until unemployment drops to well below the 5% level.

To keep unemployment from increasing further, real GNP must rise at a rate sufficient to absorb the annual increase in the labor force plus the rate of overall productivity growth. Between 1965 and 1971, the civilian labor force grew at an average annual rate of over 2%, contrasted with an average growth of less than 1.5% during the entire postwar period (1947-1971). For the entire decade of the seventies, the National Planning Association (NPA), in a study entitled Economic Projections, November 1971, estimates that the labor force will increase 1.8% per year, and more rapidly in the first than the second half of the decade.

The average postwar rate of productivity growth in the private economy has been 3.1% and, while it was slow from 1966 to 1970, productivity rose 4.6% in 1971 alone. This late spurt will likely not be sustained, but NPA forecasts an average increase rate of 3.3% per annum for 1970-1975 which seems quite possible during a recovery period. Coupled with the growing labor force,

this implies that during periods of rapidly rising productivity, real GNP must increase upwards of 5% per year merely to keep the unemployment ratio level and more rapidly to achieve decreased unemployment.

Thus, in its 1972 Annual Report, the Council of Economic Advisors estimates a 6% increase in real GNP during 1972; this rate would probably have to be maintained for another year or two to bring the unemployment ratio down to levels of 4 to 4 1/2%. Thereafter, however, real GNP would still have to increase 4 1/4 to 4 1/2% annually to keep unemployment from rising again; the 1972 Budget submitted to Congress uses a figure of 4.3%. This assumes that the spurt in productivity will have tapered off to long-range sustainable levels of about 2.5% for the total economy, and that the labor force will continue rising about 1.8% per annum for some time ahead.

NPA projects an annual growth rate for real GNP of 5.1% for 1970 to 1975, reaching $922 billion (1958 dollars) in the latter year. Since the 1971 increase was only 2.7%, this would imply a rate of 5.6% for the next four years. This is reasonably consistent with an increase rate of about 6% during 1972 and 1973, gradually tapering off toward 4.3% thereafter. If the 1975 projection of $922 billion is realized, a further 4.3% rise in 1976 would bring GNP in that year to $960 billion.

A 1976 GNP of $960 billion (1958 dollars) would imply an average annual growth rate of 5.35% between 1971 and 1976. It may be observed that such a rate is by no means out of line with those experienced during extended recovery periods. Between 1961 and 1966, for example, real GNP rose considerably faster at the average annual rate of 5.7%, and productivity growth averaged 3.9% per year.

Though we regard these expectations as realistic, there can be no firm assurance that they will be fully realized. Economic goals have not been uniformly achieved in the past, and may not be in the present case. A distinctly less optimistic assessment could contemplate a 4.3% annual rate of real GNP growth continuously from 1971 to 1976; the minimum estimated as necessary to keep unemployment from rising further. This would imply GNP of $875 billion in 1975 and $910 billion in 1976 (1958 dollars). It would also imply unemployment continuing at around 6%. Any slower growth would foreshadow a deepening recession.

While this less optimistic estimate of 4.3% annual real GNP growth exceeds the average 3.7% growth rate recorded from 1947 to 1971, this reflects the accelerated rate of increase of the labor force during recent years.

On the basis of these considerations, we have applied alternative assumptions regarding economic growth in the period 1971 to 1976 to the regression equations previously described. The first assumption is that favorable economic growth will be achieved, with 1976 GNP of about $960 billion (1958 dollars) and unemployment around 4%. The second recognizes the possibility of unfavorable developments which may hold 1976 GNP down to $910 billion, with no significant reduction in unemployment below the 6% level. We have excluded, as too remote, consideration of still slower growth, rising unemployment and deepening recession. Projected steel consumption in the light of these two assumptions is as follows:

1. The 1947-1971 regression equation was:

   $C = 22 - 1T + .158\ GNP - 2.26\ U$

   (a) If 1976 GNP is assumed at $960 billion and unemployment at 4%, steel consumption should be:

   Consumption = 22 - 30 + 151 - 10 = 133 million tons

   (b) If 1976 GNP is assumed at $910 billion and unemployment at 4%, steel consumption should be:

   Consumption = 22 - 30 + 144 - 13 = 123 million tons

2. The 1954-1971 regression equation was:

   $C = 13 - 2.56\ T + .221\ GNP - 2.4\ U$

   (a) At 1976 GNP of $960 billion and unemployment of 4%, steel consumption should be:

   Consumption = 13 - 77 + 212 = 138 million tons

(b) At 1976 GNP of $910 billion and unemployment of 6%, this becomes:

13 - 77 + 201 - 14 = 123 million tons

It is evident that the two regressions yield closely parallel results. Both, it may be noted, show distinctly lower consumption projections than the regression equations which do not include the unemployment factor.

In assessing the projections derived from our regression equations the following should be kept in mind:

- The 1947-1971 and 1954-1971 included a representative group of economic peaks and valleys
- Consumption projections using the period 1947-66 or 1954-66 as a base would contain an upward bias as 1966 came at the end of a sustained period of economic growth
- Projections based on the periods 1947, 1954-1971 should contain a downward bias as the period 1966-1971 was one of little or no real economic growth
- Thus, if 1971 steel consumption were projected from 1947, 1954-1966 bases, the results would overstate actual consumption by 1-6 million tons. If, however, a base of 1947 or 1954-1968 was used, reflecting the economic slowdown occurring in 1967 & 1968, steel consumption for 1971 would be understated nearly 4 million tons.

A further check on our equations may be derived from the Steel-GNP ratios shown in Exhibit III. The lowest ratio for the period covered (million tons to billion dollars) was .0136 for 1970. These ratios showed marked cyclical sensitivity, but little secular change since 1958. For the 1971-76 period, it is probable that any secular declining tendency would be at least balanced by the anticipated secular upturn. The 1970 ratio would then yield a consumption figure of 130.6 million tons at $960 billion GNP, and 123.7 million tons at $910 billion GNP.

(3) Sectoral Projections

The consumption estimates for 1976 prepared independently by each of eight major steel companies on the basis of sectoral demand projections range from 118 to 123.7 million tons. As we stated previously, these projections represent best estimates of 1976 steel consumption used for corporate planning purposes.

(4) Consumption Projections Summarized

The estimates of 1976 steel consumption derived above may be summarized as follows:

Source and Method	Projected 1976 Consumption (Millions of Tons) Low	Median	High
Secular growth at 2.32% from 1947-1971 Trend Line	-	114	-
Secular growth at 2.6% from 1947-1971 Trend Line	-	118	-
Industry Estimates	118.0	121.0	123.7
Time, GNP, Unemployment Regression--1947-1971	123[b]	128	133[a]
Time, GNP, Unemployment Regression--1954-1971	123[b]	131	138[a]
Estimate based on the 1970 consumption-GNP ratio of .0136	124[b]	127	131[a]

For forecasting purposes, we may narrow this range to from 120 to 130 million tons. This is not intended to exclude the possibility that the 130 million ton level may be exceeded, nor that 1976 consumption might not reach 120 millions. However, prudent company planning will probably fall within this range. If demand does exceed the upper limit, and domestic capacity is insufficient, higher imports may be expected to satisfy the shortfall.

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[a] Assuming 1976 GNP at 965 billion 1958 dollars and 4% unemployment.

[b] Assuming 1976 GNP at 910 billion 1958 dollars and 6% unemployment.

4. IMPORT PENETRATION AND MILL SHIPMENTS

The trend of foreign trade in steel is exceedingly difficult to predict, involving as it does not merely complex economic and technological considerations, but so a range of political decisions both here and abroad.

After dipping in 1969 and 1970, steel imports in 1971 spurted sharply to 18.3 million tons or over 18% of the domestic market. With exports at 2.8 million tons, net imports were 15.5 million tons.

Estimates submitted by steel industry sources to the Council have assumed a foreign trade balance ranging from 12.5 million tons of net imports at a consumption level of 118 million tons to 17.9 million tons with consumption at 123.7 million tons. Assuming exports of about 3 million tons, the range of gross imports would be from a low of some 15.5 million to a high of 21 million tons. (Virtually, the entire difference between the higher and lower consumption levels would thus be absorbed by imports). This would correspond to 13% and 17% respectively of the projected domestic market with a median about 15%. We regard this range as reasonable even at higher levels of domestic consumption.

In the absence of any clearer guides, we will assume, for the present purpose, an import penetration range of 12% to 18%, slightly broader than that derived above, with a median of 15%. The indicated levels of domestic mill shipments for 1976 corresponding to domestic consumption levels of 120, 125, and 130 million tons respectively are shown below; these figures include an allowance of 2-1/2 million tons for gross exports. The range of consumption estimates corresponds to that derived in the preceding section.

Estimated Steel Mill Shipments Under Differing Assumptions--1976
(Millions of Tons)

	Steel Mill Shipments--Including Exports		
Domestic Consumption	12%*	15%*	18%*
120	108	106	101
125	113	109	105
130	117	113	109

*Import Market Share

While these figures show the extreme range under the assumptions used, it is statistically improbable that either all the best or all the worst situations will occur together. Moreover, economic considerations suggest that import penetration will be relatively less at

lower levels of consumption and greater at higher levels. (The steel company estimates mentioned above imply this even more strongly). This would be true even under VRA or other quantitative import limitations since competitive considerations will affect the extent to which quotas are, in fact, met.

In our judgment, therefore, a median range of 106 to 113 million tons of 1976 domestic shipments may be regarded as reasonable for planning purposes. However, to assess the impact of slower than anticipated economic growth or greater than anticipated import penetration, we will include in our analysis, anticipated 1976 steel shipments of 100 million tons. If general economic recovery proceeds as forecasted, potential shipments should be at, or close to, 113 million tons and could exceed it. This involves, however, the further implicit assumption that there will be no substantial deterioration in the price competiveness of steel as against substitute materials and that domestic capacity will exist to produce such tonnage by 1976.

* * * *

The next chapter examines the steel industry's ability to produce sufficient steel to meet forecast 1976 demand.

II. DOMESTIC STEEL PRODUCTION CAPACITY

This chapter analyzes domestic steel production capacity from the standpoints of existing capacity and the increase in capacity required to meet projected 1976 steel shipments.

1. PRESENT STEEL CAPACITY

The domestic steel industry has not published official capacity estimates since 1960. Prior to 1960, the American Iron & Steel Institute (AISI) published official industry raw steel capacity (ingot tonnage) estimates. This practice was discontinued principally in the belief that estimates were sometimes being misinterpreted by the economic and financial communities.

To fill the void, The Wall Street Journal (WSJ) has published an annual estimate of domestic raw steel capacity. Essentially, the WSJ estimates represent annual updates to the last AISI estimate published in 1960. These annual updates are based on the following adjustments:

- Addition of new equipment put into operation
- Deletion of old equipment which has been scrapped

Using the above approach, the WSJ estimates domestic raw steel capacity to be 191 million ingot tons at the end of 1971.[1]

The installation of new basic oxygen furnaces (BOF's) or the razing of old, open-hearth shops are significant events within the industry and are easily recorded by the WSJ survey. Capacity, however, is also affected by two subtle factors difficult to measure using the WSJ methodology:

- Output from BOF installations has often exceeded rated capacity as a result of new technology and improved operating practices.
- Some open-hearth capacity is being retained after being superseded by new BOF installations. This is economically sound where:
  - Standby capacity is desired for peak demand periods.
  - Plant space requirements do not justify removal costs.

These two factors, of course, have opposite effects in terms of understating or overstating real capacity. Those open hearth facilities which are standing but are not usable should, however, have a greater impact on the WSJ capacity estimates. On this basis the WSJ survey should tend to overstate capacity.

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1 Drapkin, Michael K., "Steelmaking Capacity of U.S. Fell 3% in 1971 After a 24-Year Climb," The Wall Street Journal, January 19, 1972, p. 1.

Although the industry no longer publishes raw steel capacity estimates, trade sources do prepare capacity estimates for two of the three modes of production:

- Basic Oxygen Furnace
- Electric Furnace

Since these two production methods are increasing in utilization (and are technically and economically superior), the technical sources within the industry are particularly aware of new equipment installations. The two sources publishing data on basic oxygen and electric furnace capacity are:

- Association of Iron and Steel Engineers (AISE)
- Kaiser Engineers Division of Kaiser Industries Corporation

AISE publishes an annual review of industry developments which include an itemized list of worldwide steel capacity expansion and modernization programs. Kaiser Engineers, one of the world's leading steel production facilities design and construction firms, publishes an itemized list of all basic oxygen furnace installations in the world. These

sources list current annual capacity as follows:

- Basic Oxygen Furnace--78.2 million tons[2,3]
- Electric furnace capacity--"well in excess of 20.0 million tons"[4]

Using the capacities for these two production modes, the actual open-hearth production of 35.6 million tons 1971,[5] and a range of assumptions for open-hearth capacity utilization, it is possible to develop reasonable estimates of current domestic raw steel capacity. Total estimated capacity derived in this manner is shown in Exhibit V, following this page.

During 1971, BOF utilization was approximately 80%. With open-hearth furnaces considered marginal producers, it is reasonable to assume that they were operated at a significantly lower rate--60 to 65%. On this basis, total current usable raw steel capacity is estimated

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2 L-D Process Newsletter, Kaiser Engineers, Newsletter No. 57 (Chicago, Illinois, October 8, 1971, p. 1).

3 "Annual Review - Developments in the Iron and Steel Industry During 1971," Iron and Steel Engineer, January 1972, D-29.

4 Iron and Steel Engineer, January 1972, D-30.

5 Iron and Steel Engineer, January 1972, D-3.

EXHIBIT V

Council on Environmental Quality

ESTIMATED CURRENT DOMESTIC RAW STEEL PRODUCTION CAPACITY
(Million Ingot Tons)

1.	Open Hearth		
	. Actual 1971 production	35.6	35.6
	. Assumed levels of capacity utilization	65%	60%
	. Implied total production capacity	54.8	59.3
2.	Basic Oxygen Furnace	78.2	78.2
3.	Electric Furnace	23.0-25.0	23.0-25.0
	Total Estimated Capacity	156.0-158.0	160.5-163.0

to be within a range of 155-163 million tons. This range of estimated usable raw steel capacity is slightly lower than estimates provided to us by the following source:

- AISE--165 million tons

The American Iron & Steel Institute has developed a listing of Open Hearth facilities which are still in existence but considered largely inoperable. With assistance from a steel industry source, capacity figures for these facilities published by AISI in 1960 have been used to adjust the WSJ raw steel capacity estimate of 191 million tons to account for unusable capacity. The usable raw steel capacity estimates thus derived are 155-160 million tons.

Because capacity estimates involve significant uncertainties further analysis will assume a range of estimated raw steel capacity as follows:

- Low - 155 million tons
- Median - 160 million tons
- High - 165 million tons

It would not be reasonable to use estimates lower than 155 million tons, as this annual production rate was actually achieved during a short period in 1971, when steel demand was extremely high prior to a possible strike.

Installations of new rolling and finishing equipment have largely been dictated by the market's demand for materials with increased dimension, quality, or surface finish. The "Generation II" hot strip mills built in the past five years are typical of market dictated equipment changes. They were added to supply wider (80" to 86") sheet material. Similarly, finishing equipment has recently been added to supply different coated and embossed surfaces. The output capacities of equipment added for these purposes, as a general rule, significantly exceed the output capability of raw steel facilities.

To equate raw steel production capacity with the capability of the industry to ship steel products to consumers, the following adjustments are required:

- Allowances for processing losses (yield) in rolling and finishing operations
- Requirements for capacity to meet peaks in annual demand and to accommodate changes in customer product mix preferences.

Exhibit VI, following this page, shows a range of estimated steel shipment capacity developed by adjusting raw steel capacity as outlined above. While yield factors can be derived from experience, peaking factors cannot be so derived. The peaking factor used, at.92 is the result of discussions with a source in a major steel company. While

EXHIBIT VI

Council on Environmental Quality

ESTIMATED INTEGRATED STEEL CAPACITY 1972
(Millions of Tons)

	Low Estimate	Median Estimate	High Estimate
Raw Steel Capacity	155	160	165
Yield Factor[1]	.69	.69	.69
Steel Product Capacity	107	110	114
Peaking Factor	.92	.92	.92
Steel Shipment Capacity	98	101	105

(1) Estimated Average Yield 1961-1971.

this factor cannot be supported by Rigorous analysis, it is considered to be reasonable.

During periods of sustained strong demand for steel, reserve capacity required for peaking is probably less than indicated on Exhibit VI, as steel producers should be able to balance delivery schedules to smooth out large month-to-month swings in customer orders as customers absorbed consumption swings in their inventories. On the other hand, during periods of uncertain steel demand, reserve capacity required for peaking could be greater than indicated as month-to-month fluctuations in orders could be significant.

2. STEEL CAPACITY REQUIRED TO MEET 1976 PROJECTED SHIPMENTS

Exhibit VII, following this page, shows the integrated steel capacity required to meet alternative levels of projected 1976 steel shipments. For purposes of this analysis, the most significant figures are those representing "Steel Product Capacity Required" which indicates the needed level of industry integrated capacity to yield the indicated level of shipments.

Capacity requirements shown are sensitive to the peaking factor assumed. The 8% peaking factor represents an "average"

EXHIBIT VII

Council on Environmental Quality

INTEGRATED STEEL CAPACITY REQUIRED
TO MEET 1976 SHIPMENT FORECASTS
(Millions of Tons)

With 8% Peaking Factor	Low Estimate	Median Estimate	High Estimate
Projected Steel Shipments - 1976	100	106	113
Peaking Factor (1/.92)	1.087	1.087	1.087
Steel product capacity required	108.7	115.2	122.8
Yield Factor (1/.69)	1.449	1.449	1.449
Raw steel capacity required	157.5	166.9	177.9
With 4% Peaking Factor			
Projected Steel Shipments - 1976	100	106	113
Peaking Factor (1/.96)	1.042	1.042	1.042
Steel product capacity required	104.2	110.5	117.7
Yield Factor (1/.69)	1.449	1.449	1.449
Raw steel capacity required	151.9	160.1	170.5

reserve capacity requirement taking into account periods of both sustained and uncertain steel demand. The 4% peaking factor represents possible capacity requirements during periods of strong sustained demand for steel with a relatively stable product mix.

Exhibit VIII, following this page, shows the increments to steel capacity required under varying assumptions as to present integrated steel capacity and 1976 steel shipments. The range of additional integrated capacity requirements is zero to 16 million tons.

* * * *

Chapter III, which follows, analyzes steel industry capital expenditure requirements for replacement of existing plant and equipment and capacity expansion.

EXHIBIT VIII

Council on Environmental Quality

ADDITIONAL INTEGRATED STEEL CAPACITY
REQUIRED TO MEET PROJECTED 1976
STEEL SHIPMENTS
(Millions of Tons)

	Low Estimate	Median Estimate	High Estimate
Steel Shipments - 1976	100	106	113
Steel Product Capacity Required (8% Peaking Factor)	109	114	123
Additional Steel Product Capacity Required to Meet Forecast Shipments at Present Steel Product Capacity of:			
107 Million Tons	2	8	16
110 Million Tons	-	5	13
114 Million Tons	-	-	9
Steel Product Capacity Required (4% Peaking Factor)	104	110	118
Additional Steel Product Capacity Required to Meet Forecast Shipments at Present Steel Product Capacity of:			
107 Million Tons	-	3	11
110 Million Tons	-	-	8
114 Million Tons	-	-	4

III. STEEL INDUSTRY CAPITAL INVESTMENT REQUIREMENTS 1972-1976

1. INTRODUCTION

Steel industry capital expenditure requirements can be divided into two major categories:*

- Expenditures to modernize and replace existing plant and equipment
- Expenditures to increase productive capacity

This chapter analyzes capital expenditure requirements in both categories for the period 1972-1976 and projects total industry requirements over the range of projected steel shipments.

2. CAPITAL EXPENDITURES TO MODERNIZE AND REPLACE EXISTING PLANT AND EQUIPMENT

In any capital intensive industry, it is necessary to maintain a minimum continuing rate of capital investment to modernize and replace existing production capacity.

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* Capital investment requirements discussed in this report exclude consideration of any requirements potentially mandated by the Occupational Safety and Health Act or other legislation not concerned with pollution abatement.

One method of estimating capital reinvestment requirements for capital intensive industries is to relate capital reinvestment to annual depreciation. A study of capital reinvestment to annual depreciation. A study of capital reinvestment rates in several capital extensive industries, including the steel industry, which we completed in 1970 for the Naval Ship Systems Command indicate the following relationships between capital expenditures and depreciation:

- Firms planning for no significant capacity increases in the long run invest an average of 120-130% of their annual depreciation.
- Rapidly expanding firms may invest in excess of 200% of annual depreciation.
- Average depreciation rates on the Net Book Value of Plant and Equipment for the firms surveyed ranged from 6 to 20 years with a median of 11 years.

In general, it was found that the differential between annual depreciation and capital expenditures for firms in the 120-130% range was accounted for largely by inflation.

The average depreciation rate on book value of plant and equipment for the steel industry is approximately 13.5 years reflecting, in part, the relatively long life of plant and equipment in this industry.

For purposes of this analysis, we have applied a capital reinvestment rate of 125% of 1971 estimated steel industry depreciation to determine a minimum industry capital investment rate. Exhibit IX, following this page, shows a minimum average capital reinvestment rate for the steel industry of $1.37 billion annually (in constant 1971 dollars) with total minimum investment for the period 1972-1976 of $6.85 billion in constant dollars.

It should be noted that the figures shown in Exhibit IX are averages applicable over the long term. In practice, investment can vary widely from year to year.

3. CAPITAL INVESTMENT REQUIRED TO EXPAND CAPACITY

Estimates provided to us by AISE and AISI indicate that the present cost of integrated steel capacity is approximately $500 per ton. This estimated cost applies to construction of entirely new facilities "from the meadow up" and not to the cost of expanding existing facilities. Because some of the capacity increase required between 1972 and 1976 could be achieved by expanding existing facilities, the average cost per ton for capacity expansion should be somewhat less than $500.

EXHIBIT IX

Council on Environmental Quality

ESTIMATE OF CAPITAL EXPENDITURES
REQUIRED FOR MODERNIZATION AND
REPLACEMENT OF EXISTING FACILITIES
(Billion Dollars - 1971 Value)

1. Depreciation - 1971

Capitalization Year End 1970	$14.1*
Capital Expenditures (1.3) (.5)	.65
Depreciation Base 1971	$14.75

$$\frac{\text{Depreciation Base}}{\text{Depreciable Life}} = \frac{14.75}{13.5} = \$\ 1.095$$

2. Required Capital Reinvestment - % of Depreciation — 125 (%)

3. Capital Expenditure Per Year for Modernization and Replacement of Existing Facilities

($1.095) (1.25) = $ 1.37

4. Total Capital Expenditures, 1972-1976

($1.37) (5) = $ 6.85

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* Source: AISI; represents approximately 90% of the steel industry

A rigorous approach to estimating the cost of additional capacity is not possible within the scope of this study. As a consequence, cost estimates must be judgmental.

Two approaches to estimated the cost of additional capacity were used. The following table is an estimate derived by reviewing the cost components of additional capacity:

Facilities *	Full Cost/Ton	Factors	Cost/Ton for Capacity/ Expansion
**Raw Materials, Transportation & Ore Yard	$ 44.00	.50	$ 22.00
Coke Processing	52.25	.50	26.13
Blast Furnaces	78.00	.50	19.00
BOF or Electric Furnaces	76.00	1.00	76.00
Rolling Mills	85.50	.20	17.10
Power Supply	85.50	.50	42.75
Utilities and Water	85.50	.50	42.75
Administrative Facilities	33.25	-0-	-0-
Total	$500.00	.49	$245.73

* Source: Association of Iron & Steel Engineers
** Partially estimated by Booz, Allen Public Administration Services, Inc.

The estimated average cost per ton for additional capacity at $246 reflects judgments regarding the potential for expanding existing facilities. In the table above, it was assumed that, for a capacity expansion of up to 16 million tons which would

represent a minimum capacity increase of 15%, the average cost of expanding most production facilities would be approximately 50% of the full "meadow up" cost. In the case of rolling mills it was assumed that only minor expansion would be required as current rolling capacity significantly exceeds raw steelmaking capacity. Conversely, it was estimated that no savings were available in expanding raw steel capacity.

Another approach to estimating the cost of additional capacity is to use a sliding scale which relates average cost per ton to the amount of capacity added:

Cost Per Ton	Capacity Increment
$200	1st million tons
$275	2nd million tons
$350	3rd million tons
$425	4th million tons
$500	All additional capacity increments

The above table which shows average cost per ton increasing from $200 to a full cost of $500 for the 5th increment of one million tons reflects the judgment that limited economies are available through the expansion of existing productive facilities. This approach is favored by sources in a major steel producer on the basis that the benefits of "rounding out" existing facilities

were largely exhausted in the course of industry modernization and expansion projects completed over the last 5-7 years. Using the sliding scale the average cost per ton for capacity expansion of 16 million tons would be $422 per ton as opposed to the estimate of $246 per ton derived previously.

The uncertainty factor associated with estimates of the cost per ton of additional capacity increases in significance as the estimated amount of incremental capacity required to meet alternative demand/capacity situations increases.

While it is not objectively possible to evaluate which approach to estimating the cost of additional capacity is more accurate, the estimates based on the sliding scale will be used in further analysis for purposes of conservatism. It should be kept in mind, however, that use of the sliding scale does not rule out the possibility that capacity expansion at a lower average cost per ton could be possible.

Exhibit X, (1, 2) following this page, shows the range of estimated capital expenditures required to expand capacity, under alternative assumptions as to present steel industry capacity and 1976 steel shipments. It should be noted that

EXHIBIT X (1)

Council on Environmental Quality

CAPITAL EXPENDITURES REQUIRED
TO EXPAND CAPACITY TO MEET ALTERNATIVE
1976 STEEL SHIPMENT PROJECTIONS
(Assumes 8% Peaking Factor)

	Low Estimate	Median Estimate	High Estimate
		(millions of tons)	
Projected Steel Shipments	100	106	113
Additional Capacity Required - Present Capacity of: (Exhibit VIII)			
107 Million Tons	2	8	16
110 Million Tons	-	5	13
114 Million Tons	-	1	9
Capital expenditures required* with present capacity of:		(billions of 1971 $)	
107 Million Tons	0.43	2.93	6.53
110 Million Tons	-	1.58	5.18
114 Million Tons	-	0.18	3.38

*Totals are reduced by 10% for compatibility with AISI industry figures.

EXHIBIT X (2)

Council on Environmental Quality

CAPITAL EXPENDITURES REQUIRED
TO EXPAND CAPACITY TO MEET ALTERNATIVE
1976 STEEL SHIPMENT PROJECTIONS
(Assumes 4% Peaking Factor)

	Low Estimate	Median Estimate	High Estimate
		(Millions of tons)	
Projected Steel Shipments	100	106	113
Additional Capacity Required - Present Capacity of: (Exhibit VIII) -			
107 Million Tons	-	3	11
110 Million Tons	-	-	8
114 Million Tons	-	-	4
Capital expenditures required* with present capacity of:		(billions of 1971 $)	
107 Million Tons	-	0.75	4.28
110 Million Tons	-	-	2.93
114 Million Tons	-	-	1.13

*Totals are reduced by 10% for compatibility with AISI industry figures.

dollar figures have been reduced by 10 percent for compatibility with AISI financial reports which cover approximately 90% of the steel industry. AISI financial statistics have been used as the basis for analysis in following chapters. Exhibit XI (1, 2) following this page, shows the range of estimated capital expenditures required for both capacity renewal and expansion. The range of estimated capital expenditures shown on Exhibit XI (1, 2) at $6.85 billion to $13.38 billion depends on the following elements:

- Current productive capacity
- 1976 Shipments
- Reserve capacity required to meet peak demand levels

As indicated previously, since each of these elements is subject to undertainty, the range of possible capital expenditure requirements is wide.

If an average cost per ton for additional capacity of $246 were used in the preceding analysis, the range of estimated capital expenditures for routine capacity replacement and necessary expansion would be $6.85 billion to $9.73 billion. The range of required capital expenditures indicated in each above case excludes any expenditures to replace facilities which may be shut down as a result of pollution abatement and any additional expenditures (over and above past levels) for pollution abatement itself.

EXHIBIT XI (1)

TOTAL CAPITAL EXPENDITURES REQUIRED
FOR CAPACITY EXPANSION
AND RENEWAL - 1972-1976
(BILLIONS OF 1971 $)
(Assumes 8% Peaking Factor)

	Low Estimate	Median Estimate	High Estimate
Projection Steel Shipments (Millions of tons)	100	106	113
Capital Expenditures Required for Capacity Expansion with Present Capacity of:			
107 Million Tons	0.43	2.93	6.53
110 Million Tons	-	1.58	5.18
114 Million Tons	-	0.18	3.38
Capital Expenditures for Routine Capacity Replacement *	6.85	6.85	6.85
Total Capital Expenditures Required at Present Capacity of:			
107 Million Tons	7.28	9.78	13.38
110 Million Tons	6.85	8.43	12.03
114 Million Tons	6.85	7.03	10.23

* Excludes expenditures to replace facilities possibly shut down as a result of pollution abatement and expenditures for air and water pollution abatement itself.

EXHIBIT XI (2)

TOTAL CAPITAL EXPENDITURES REQUIRED
FOR CAPACITY EXPANSION
AND RENEWAL - 1972-1976
(BILLIONS OF 1971 $)
(Assumes 4% Peaking Factor)

	Low Estimate	Median Estimate	High Estimate
Projection Steel Shipments (Millions of tons)	100	106	113
Capital Expenditures Required for Capacity Expansion with Present Capacity of:			
107 Million Tons	-	0.75	4.28
110 Million Tons	-	-	2.93
114 Million Tons	-	-	1.13
Capital Expenditures for Routine Capacity Replacement *	6.85	6.85	6.85
Total Capital Expenditures Required at Present Capacity of:			
107 Million Tons	6.85	7.60	11.13
110 Million Tons	6.85	6.85	9.78
114 Million Tons	6.85	6.85	7.98

* Excludes expenditures to replace facilities possibly shut down as result of pollution abatement and expenditures for air and water pollution abatement itself.

Pollution abatement related expenditures are discussed in Chapter V.

Direct comparisons of projected capital expenditures with past steel industry expenditures are not valid as it is impossible to relate such expenditures to changes in capacity. As a matter of interest, however, actual steel industry capital expenditures for the period 1967-1971 were approximately $9.6 billion.

* * * *

Chapter IV, which follows, covers pollution abatement costs and their sensitivity to alternative levels of demand.

IV. POLLUTION ABATEMENT COSTS

This chapter evaluates air and water pollution abatement cost estimates prepared by the Council in terms of the sensitivity of these estimates to alternative capacity and production levels.

1. POLLUTION ABATEMENT COSTS

Exhibit XII, following this page, contains air and water pollution abatement capital and operating cost estimates supplied by the Council. These estimates exclude pollution abatement costs for non-steel production facilities owned by steel producers.

Across this range of estimates shown (low-high), total capital investment required (1972-1976) varies from $2.4 billion to $3.5 billion. Estimated annual operating costs, including depreciation and interest, range from approximately $761 million to 1.1 billion by 1976. It should be noted that operating cost estimates assume that all capital investment is financed through borrowing at an average interest rate of 10% per year.

EXHIBIT XII (1)

Council on Environmental Quality

ESTIMATED AIR POLLUTION ABATEMENT COSTS
1972-1976
(in millions)
(Constant 1971 Dollars)

	Year				
	1972	1973	1974	1975	1976
Best Estimate					
Capital Investment	$132	$217	$643	$728	$217
Annual Costs					
Operation and Maintenance	$ 16	$ 48	$160	$288	$320
Interest	10	29	97	175	194
Depreciation	10	29	97	175	194
Subtotal	36	106	354	638	708
Investment Credit*	(9)	(15)	(45)	(51)	(15)
Total Annual Cost	$ 27	$ 91	$309	$587	$693
High Estimate (+25%)					
Capital Investment	$165	$271	$804	$910	$271
Annual Costs	$ 34	$114	$386	$734	$866
Low Estimate (-10%)					
Capital Investment	$119	$195	$579	$655	$195
Annual Costs	$ 24	$ 82	$278	$528	$624

* Computed by Booz, Allen Public Administration Services, Inc.

Source: Council on Environmental Quality

EXHIBIT XII (2)

Council on Environmental Quality

ESTIMATED WATER POLLUTION ABATEMENT COSTS
1972-1976
(in millions)
(Constant 1971 Dollars)

	Year				
	1972	1973	1974	1975	1976
Best Estimate					
Capital Investment	$154	$161	$169	$176	$183
Annual Costs					
Operation and Maintenance	$ 17	$ 33	$ 50	$ 67	$ 84
Interest	15	30	45	59	75
Depreciation	7	15	22	30	37
Subtotal	$ 39	$ 78	$117	$156	$196
Investment Credit*	(11)	(11)	(12)	(12)	(14)
Total Annual Cost	$ 28	$ 67	$105	$144	$182
High Estimate (+30%)					
Capital Investment	$200	$209	$220	$229	$238
Annual Costs	$ 36	$ 87	$137	$187	$237
Low Estimate (-25%)					
Capital Investment	$116	$121	$127	$132	$137
Annual Costs	$ 21	$ 50	$ 79	$108	$137

* Computed by Booz, Allen Public Administration Services, Inc.

Source: Council on Environmental Quality

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2. DATA SOURCES USED

Basic data from which the Council derived cost estimates came from the following sources:

- Environmental Protection Agency--Water pollution abatement cost data
- Battelle Memorial Institute--Air pollution abatement cost data
- Research Triangle Institute--Estimated steel industry capacity and production

While the scope of this study precluded a detailed examination of air and water pollution abatement cost date, steel industry capacity and production estimates used to derive industry-wide costs were examined in some detail. The methodology used together with the capacity and production estimates derived are as follows:

- The period considered was 1967-1977
- Estimates used by the Council were originally prepared in 1967 and updated in 1971
- Capacity was estimated in terms of raw steel production, based on continuous surveys of steel industry plant and equipment:
  - Estimates were adjusted to eliminate capacity considered not economically usable.
  - 1967 usable raw steel capacity was estimated at 165 million tons
  - Capacity growth from 1967-1977 was projected at 2.1% per year as updated in 1971.

- Implied capacity for 1972 and 1976 was:

  . 1972--183 million tons
  . 1976--199 million tons

- Production estimates were expressed in terms of raw steel, based on a long-term trend analysis:

  - 1967 production was estimated to be 127 million tons.

  - The compound annual growth rate used for projecting production was 2.5%

  - Implied 1972 and 1976 production was:

    . 1972--144 million tons
    . 1976--158 million tons

  - Implied 1972 and 1976 steel shipments, based on a yield factor of .683 would be:

    . 1972-- 98 million tons
    . 1976-- 108 million tons

Capacity estimates for 1972 and 1976 used to develop pollution abatement cost estimates are significantly higher than those detailed in Chapters II and III, possibly, because of the difficulty in identifying that raw steel capacity which is carried on producers books but is in fact not usable.

The production estimate for 1972 is 2-5 million tons higher than current estimates allow for while implied steel shipments for 1976 fall within the Median-High range of projected 1976 shipments detailed in Chapter I.

Because a number of steps in the production of steel, notably coking and sintering, were omitted in the original cost estimates supplied by the Council, a large adjustment to total capital investment costs, on the order of $1 billion, was made in preparing the estimates shown on Exhibit XII. Operating costs, including interest and depreciation were similarly adjusted.

3. THE SENSITIVITY OF POLLUTION ABATEMENT COSTS

Exhibit XIII, following this page, compares 1976 raw steel capacity and production implied in the pollution abatement cost estimates with capacity and production projections for that year as detailed in preceding chapter. As shown on the exhibit, it would appear that pollution abatement capital investment requirements, based on 1976 capacity estimates, may be overstated on the order of 11% to 20%. This would also apply to annual depreciation and interest costs. On the other hand, operation and maintenance costs, assuming 1976 steel shipments in the median-high range of our estimates, may be slightly understated. This assumes, of course, that costs vary in direct proportion to capacity and shipments, an assumption which cannot be evaluated within the scope of this study.

The steel industry, through AISI, has estimated that capital investment required to meet pollution abatement requirements by

EXHIBIT XIII

Council on Environmental Quality

COMPARISON OF 1976 STEEL CAPACITY AND SHIPMENTS IMPLIED IN ABATEMENT COST ESTIMATES WITH PROJECTIONS PREPARED BY BOOZ, ALLEN

Raw Steel Capacity 1976
(Millions of Tons)

Implied in Abatement Cost Estimates	Estimated by Booz, Allen			Variance %		
	Low	Median	High	Low	Median	High
199	158	167	178	-20.0	-16.1	-10.6

Net Steel Shipments 1976
(Millions of Tons)

Implied in Abatement Cost Estimates	Estimated by Booz, Allen			Variance %		
	Low	Median	High	Low	Median	High
108	100	106	113	-8.0	1.8	+ 4.6

1976 is approximately $3.5 billion which is very close to the high estimate supplied by the Council. If the variances noted in the exhibit are applied to the Council's high estimates of pollution abatement capital requirements, the results would be as follows:

	Capital Investment 1972-1976 (Millions of Dollars)
CEQ High Estimate	$3,517
At Capacity Variance of	
-20.0%	2,814
-16.1%	2,951
-10.6%	3,145

Operating cost variances would of course be smaller.

Despite the variances listed above, pollution abatement capital and operating costs would still fall into the "best estimate"-high range supplied by CEQ. Since CEQ cost estimates cover a broad range, no additional accuracy would be gained by further adjusting them. Consequently, the balance of this report will assume that air and water pollution abatement cost estimates, as supplied by CEQ, remain constant across the ranges of production (steel shipments) and capacity estimates contained in Chapters I, II and III.

4. ACCELERATED CAPITAL EXPENDITURES RESULTING FROM POLLUTION ABATEMENT REQUIREMENTS

Pollution abatement requirements will result in accelerated replacement of some facilities which would be uneconomical to clean up. Replacement of such facilities would be in addition to the normal replacement of facilities as they wear out. A steel industry source has estimated that over the period 1972-1976, $2.5 - $3.0 billion would be the most probable range of investment for this purpose. It is estimated that these expenditures would be concentrated approximately as follows:

	Net Added Capital Expenditures (Millions of 1971 $)
. Replacement of Obsolete Blast Furnaces	$1,850
. Replacement of sintering plants with ore pelletizing plants	700
. Replacement of Open Hearth Furnaces	200
Total	$2,750

The breakdown shown above represents the midpoint of the range of estimates provided to us.

On balance, however, the problem of accelerated capital expenditures must be viewed in the following context:

- In cases where steel producers may legally do so, there may be short term tradeoffs available in allocating capital expenditures for normal equipment replacement and modernization to accelerated replacement of facilities affected by pollution abatement. This would involve deferring capital expenditures earmarked for other facilities with some increase in operating costs resulting in those facilities

- In deciding what to do about pollution abatement requirements with reference to a given facility three options are available:

  - Replace the facility
  - "Clean up" the facility
  - Shut down the facility without replacement

- If funds for facility replacement are not available, no matter what the advantages of facility replacement are, the options become limited to clean up or shut down. Thus, while it may be preferable to replace a facility rather than clean it up, it may also be preferable to clean up the facility rather than shut it down, in the absence of available funds for replacement. Cleanup expenditures in such situations could to some extent be duplicated in in following years as affected facilities were replaced in their normal manner.

To assess the true impact of accelerated capital expenditures on pollution abatement costs, the above factors must be carefully evaluated. Such analysis is not possible within the scope of this assignment.

For purposes of this analysis it has been assumed that the range of possible accelerated capital expenditures is zero-$2.75 billion. The assumption of zero presumes the following situations:

- All affected facilities are "cleaned up" without replacement
- Replacement of affected facilities is accomplished using normal facility replacement funds by deferring other expenditures

The assumption of $2.75 billion presumes that all affected facilities must be replaced sooner than would be the case of pollution abatement were of no concern.

The following chapter contains steel industry financial projections for the period 1972-1976, comparing results before and after consideration of pollution abatement costs.

V. THE IMPACT OF POLLUTION ABATEMENT COSTS ON INDUSTRY GROWTH AND PROFITS

1. BASELINE PROFIT AND LOSS PROJECTIONS (Excludes Pollution Abatement Costs)

Exhibit XIV (1, 2, 3) contains Pro Forma Steel Industry Profit and Loss Statements for the period 1971-1976. Sales and profits reported for 1971 by eight representative steel firms were sampled in preparing the statement shown for 1971. On the basis of this sampling, the estimated net profit for 1971 at $578 million should closely approximate actual industry results as reported to AISI*.

Financial information reported to AISI includes costs and profits associated with non-steelmaking activities of reporting companies. However, any distortions which might result from this factor are not sufficient to significantly influence the results of the analysis.

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* Companies reporting to AISI produce approximately 90% of domestic net steel shipments. Consequently, all figures used in this chapter, including pollution abatement costs, reflect 90% of industry wide totals.

EXHIBIT XIV (1)
Council on Environmental Quality
Steel Industry Pro Forma Profit & Loss Statements
(Millions of Dollars)
c Projected 1976 Industrywide Steel Shipments - 100 million tons
o 1972 Industry Steel Product Capacity - 110 million tons
1971-1976

	Estimated*	Projected				
	1971	1972	1973	1974	1975	1976
Net Steel Shipments (million tons)	77.7	83.2	85.6	86.8	88.6	90.4
Assumed Yearly Price Increase (%)	6.8	8.0	4.0	4.0	3.0	3.0
Operating Revenues	$19,085	$22,070	$23,450	$24,905	$26,184	$27,518
Dividends, Interest, etc.	210	243	258	274	288	303
Total Revenue	$19,295	$22,313	$23,708	$25,179	$26,472	$27,821
Employment Expenses	$ 7,612	$ 8,852	$ 9,441	$10,008	$10,522	$11,058
Materials & Services	9,131	10,169	10,701	11,255	11,833	12,436
Total	$16,743	$19,021	$20,142	$21,263	$22,355	$23,494
Gross Margin	$ 2,552	$ 3,292	$ 3,566	$ 3,916	$ 4,117	$ 4,327
Other Expenses:						
Depreciation, Depletion & Amortization	$ 1,158	$ 1,260	$ 1,366	$ 1,475	$ 1,587	$ 1,703
Interest	288	288	288	288	288	288
Profit Before Taxes	1,106	1,744	1,912	2,153	2,242	2,336
Federal, State & Local Taxes	$ 528	$ 808	$ 892	$ 1,016	$ 1,058	$ 1,104
Net Income	578	936	1,020	1,137	1,184	1,232
Investment Credit	47	99	102	104	108	111
Net Income - % Total Revenue	3.0	4.2	4.3	4.5	4.5	4.4

* Actual 1971 Net Income $568 million

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EXHIBIT XIV (2)

Council on Environmental Quality

Steel Industry Pro Forma Profit & Loss Statements
(Millions of Dollars)
- Projected 1976 Industrywide Steel Shipments - 106 million tons
- 1972 Industry Steel Product Capacity - 110 million tons

1971-1976

	Estimated*	Projected				
	1971	1972	1973	1974	1975	1976
Net Steel Shipments (million tons)	77.7	82.8	86.0	89.1	92.3	95.4
Assumed Yearly Price Increase (%)	6.8	8.0	4.0	4.0	3.0	3.0
Operating Revenues	$19,085	$21,965	$23,726	$25,565	$27,277	$29,038
Dividends, Interest, etc.	210	242	261	281	300	319
Total Revenue	$19,295	$22,207	$23,987	$25,486	$27,577	$29,357
Employment Expenses	$ 7,612	$ 8,746	$ 9,553	$10,273	$10,962	$11,669
Materials and Services	9,131	10,120	10,827	11,554	12,328	13,124
Total	$16,743	$18,866	$20,380	$21,827	$23,290	$24,793
Gross Margin	$ 2,552	$ 3,341	$ 3,607	$ 4,019	$ 4,287	$ 4,564
Other Expenses:						
Depreciation, Depletion & Amortization	$ 1,158	$ 1,272	$ 1,402	$ 1,536	$ 1,674	$ 1,816
Interest	288	288	288	288	288	288
Profit Before Taxes	1,106	1,781	1,917	2,195	2,325	2,460
Federal, State & Local Taxes	$ 528	$ 804	$ 820	$ 1,012	$ 1,077	$ 1,142
Net Income	578	977	1,097	1,183	1,248	1,318
Investment Credit	47	122	125	129	132	139
Net Income - % Total Revenue	3.0	4.4	4.6	4.6	4.5	4.4

* Actual 1971 Net Income $568 million

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EXHIBIT XIV (3)

Council on Environmental Quality

Steel Industry Pro Forma Profit & Loss Statements
(Millions of Dollars)

- Projected 1976 Industrywide Steel Shipments - 113 million tons
- 1972 Industry Steel Product Capacity - 110 million tons

	Estimated*	Projected				
	1971	1972	1973	1974	1975	1976
Net Steel Shipments (million tons)	77.7	85.9	89.9	94.0	98.1	102.2
Assumed Yearly Price Increase (%)	6.8	8.0	4.0	4.0	3.0	3.0
Operating Revenues	$19,085	$22,787	$24,802	$26,970	$28,991	$31,110
Dividends, Interest, etc.	210	251	273	297	319	342
Total Revenue	$19,295	$23,038	$25,075	$27,267	$29,310	$31,452
Employment Expenses:	$ 7,612	$ 9,056	$ 9,799	$10,574	$11,311	$12,078
Materials & Services	9,131	10,498	11,318	12,189	13,102	14,060
Total	$16,743	$19,554	$21,117	$22,763	$24,413	$26,138
Gross Margin	$ 2,552	$ 3,484	$ 3,958	$ 4,504	$ 4,897	$ 5,314
Other Expenses:						
Depreciation, Depletion & Amortization	$ 1,158	$ 1,300	$ 1,486	$ 1,678	$ 1,875	$ 2,078
Interest	288	288	288	288	288	288
Profit Before Taxes	1,106	1,896	2,184	2,538	2,734	2,948
Federal, State & Local Taxes	$ 528	$ 813	$ 957	$ 1,136	$ 1,232	$ 1,338
Net Income	578	1,083	1,227	1,402	1,502	1,610
Investment Credit	47	173	179	184	150	195
Net Income - % Total Revenue	3.0	4.7	4.9	5.1	5.1	5.1

*Actual 1971 Net Income - $568 million

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The three alternative projections shown in Exhibit XIV reflect the following assumptions regarding steel industry production capacity and probable output (net shipments).

- Exhibit XIV (1)
  - Steel shipments by 1976 of 100 million tons
  - Steel product capacity in 1972 of 110 million tons
- Exhibit XIV (2)
  - Steel shipments by 1976 of 106 million tons
  - Steel product capacity in 1972 of 110 million tons
- Exhibit XIV (3)
  - Steel shipments by 1976 of 113 million tons
  - Steel product capacity in 1972 of 110 million tons.

The projections contained in Exhibit XIV reflect estimates of shipments and capacity as detailed in Chapters I and II. Capacity requirements reflect an 8% peaking factor.

The assumptions used in preparing the statements in Exhibit XIV are detailed below. The sensitivity of these assumptions will be discussed in a subsequent section.

(1) Steel Prices

Average year-to-year price increases were estimated as follows:

- The estimated 1970-1971 price increase at 6.8% is based on the Wholesale Price Index average year to year increase for steel mill products (7.6%) adjusted to account for volume peaks during the first half of the year.

- The estimated 1971-1972 price increases at 8.0% reflects the full impact of price increases announced during 1971 (+12% Average 1970-December 1971) and the impact of price increases in effect or to take effect in 1972 *

- Price increases assumed for the period 1973-1976 are as follows:

Year	%
1973	+4.0
1974	+4.0
1975	+3.0
1976	+3.0

* The price freeze announced by Bethlehem Steel to extend through December 31, 1972 would reduce estimated industry 1971-72 price increases from 8.0% to 7.2%. This would reduce projected industry 1972 Net Income by approximately $100 million. (Exhibit XIV-2). If 1972 price increases foregone as a result of the freeze were not made up, the cumulative reduction of projected Net Income through 1976 would be approximately $550 million. It is probable that steel producers will make every effort to make up price increases foregone during the freeze as soon as the freeze period ends. Such increases would appear to be justified on the basis of current industry cost and profit factors.

(Continued)

- The price increases for 1973-1976 reflect the following:

  - Increases necessary to cover assumed cost increases, as detailed below

  - Increases necessary to bring profit margins up to historical levels

While the Wholesale Price Index in many cases may not reflect the impact on realized steel prices of unpublished price concessions by producers to major customers, the events of 1971 strongly suggest that estimated price increases on the order of 6.8% for 1971 and 8.0% for 1972 should be considered realistic.

- During 1971 net steel shipments decreased by 6.5% from 1970 levels

- An analysis of 1971 operating results reported by eight steel producers which accounted for 77% of the total steel industry revenues reported by AISI for 1970, indicates 1971 revenues increased an average of 5.0% over 1970 levels

- The increase in 1971 revenues coupled with the decrease in shipments indicate significant realized steel price increases in 1971 (at least 6.8%)

The extent and timing of "makeup" price increases will depend on market factors and possibly the effects of price controls. In 1971 Bethelehem Steel was the most profitable of the major steel producers. If Bethlehem is prevented from raising prices after the freeze ends due to profit margin limitations imposed by the Price Commission, it is highly unlikely that less profitable producers could raise prices due to competitive constraints.

(2) Labor Cost Increases

Labor cost increases were estimated on the basis of assumed wage increases, partially offset by productivity increases. Estimated wage rate and productivity increases are shown below:

		Exhibit XIV (3)		Exhibit XIV (1, 2)	
Year	Wage Rates	Productivity	Labor Cost	Productivity	Labor Cost
1971	+ 8.9	+3.5	+5.4	+3.5	+5.4
1972	+11.6	+4.0	+7.6	+3.0	+8.6
1973	+ 7.4	+4.0	+3.4	+3.0	+4.4
1974	+ 6.7	+3.5	+3.2	+3.0	+3.8
1975	+ 5.5	+3.0	+2.5	+2.5	+3.0
1976	+ 5.5	+3.0	+2.5	+2.5	+3.0

Wage increases for the year 1971-1974 reflect the impact of the steel industry wage settlement effective August 1, 1971. For the years 1974-1976 a wage rate increase of 5.5% per year, effective August 1, was assumed. This is in line with present wage guidelines. Assumed productivity increases are based on the following factors:

(Productivity is discussed in detail in Section 4 of this Chapter)

- Steel industry productivy increased by 3.3% during 1971

- Productivity increases over the period 1972-1976 are based on the assumption of increasing production volume leading to efficient capacity utilization, the impact on productivity of new efficient facilities completed and debugged over the past 2-5 years, and the impact on productivity of capital spending for modernization and capacity expansion

- Productivity increases projected on Exhibit XIV (1, 2) are lower than increases projected on Exhibit XIV (3) due to a lower assumed rate of growth in output (100-106 million tons in 1976 vs. 113 million tons)

(3) Materials and Services Cost Increases

Annual unit cost increases for materials and services were assumed as follows:

	%
1971	+6.5
1972	+4.0
1973-1976	+3.0

Cost increases for 1972-1976 are higher than government goals at 2.5% per year, reflecting the possibility that such goals may not be fully attained.

(4) Depreciation Expense

Projected depreciation expense increases are based on projected capital expenditures. The average rate of depreciation used was 13.5 years, on a straight line basis. No extraordinary write-offs were assumed.

(5) Interest Costs

Interest costs were assumed constant at 1970 levels as no new net borrowing is postulated (excludes pollution abatement financing). Increases in interest costs associated with rolling over debt were considered to be insignificant in terms of this analysis.

2. SENSITIVITY OF STEEL INDUSTRY PROFITABILITY

Exhibit XIV, following page 47, indicates a recovery of steel industry profits from 1970-1971 levels. This projected recovery is based on the following rationale:

- Steel shipments have dropped sharply during 1970 and 1971 from 1968-1969 levels reflecting mainly the influence of the recession.

Year	Net Shipments* (Million Tons)	% Increase (Dec.)	Cumulative %
1968	87.5	N/A	N/A
1969	86.4	(1.3)	(1.3)
1970	82.2	(4.9)	(6.1)
1971	77.7	(5.5)	(11.2)

- Coincident with the decline in shipments there has been a sharp decline in profits ($992 million in 1968 to $513 million in 1970)

* Shipments by companies reporting financial statistics to AISI-1971, estimated by Booz, Allen Public Administration Services, Inc.

- While shipments decreased significantly from 1970 to 1971 (-5.5%), industry net profits advanced slightly and productivity (output per man hour) increased.

- With 1972 shipments projected to increase by 5.5 million tons or 6.4%, it is logical to expect significant gains in profits, especially in view of expected price and productivity increases. (Projected 1972 profits represent an increase of 62% - 87% over 1971 levels.)

While the projections in Exhibit XIV represent a range of estimates as to steel industry profit performance over the next 5 years, it should be clearly understood that such performance is subject to the behavior of many factors underlying the projections.

Exhibit XV, following this page, presents projected steel industry profit and loss statements from Exhibit XIV (2) in constant 1971 and inflated 1972-1976 dollars. Exhibit XVI, following Exhibit XV, summarizes the impact of inflation on pretax profit. It is significant to note that increased operating revenues of $18.1 billion are projected to produce $1.2 billion in pretax profit. The balance of revenues, $16.9 billion or 93.4% of the total, is absorbed by projected cost increases. Total pretax profits are accounted for below:

	$ (In Millions)	%
Price Increases	1,217	11.4
Productivity Increases	3,859	36.1
Volume of Shipments	5,602	52.5
Total	10,678	100.0

EXHIBIT XV

Council on Environmental Quality

COMPARISON OF PROJECTED STEEL INDUSTRY P & L STATEMENTS
IN CONSTANT 1971 AND INFLATED (1972-1976) DOLLARS
(Millions of Dollars)

- Projected 1976 Industrywide Steel Shipments - 106 million tons
- 1972 Industry Steel Product Capacity - 110 million tons

	1972		1973		1974		1975		1976	
	Pro Forma	1971$	Pro Forma	1971$	Pro Forma	1971$	Pro Forma	1971$	Pro Forma	1971$
Operating Revenues	$21,965	$20,337	$23,726	$21,123	$25,565	$21,885	$27,277	$22,671	$29,038	$23,432
Dividends, Interest, etc	242	224	261	232	281	241	300	249	319	258
Total	$22,207	$20,561	$23,987	$21,335	$25,846	$22,126	$27,577	$22,920	$29,357	$23,690
Employment Expenses	$ 8,746	$ 7,868	$ 9,553	$ 7,927	$10,273	$ 7,967	$10,962	$ 8,006	$11,669	$ 8,027
Materials & Services	10,120	9,731	10,827	10,106	11,554	10,471	12,328	10,847	13,124	11,211
Total	$18,866	$17,599	$20,380	$18,033	$21,827	$18,438	$23,290	$18,853	$24,793	$19,238
Gross Profit	$ 3,341	$ 2,962	$ 3,607	$ 3,322	$ 4,019	$ 3,688	$ 4,287	$ 4,067	$ 4,564	$ 4,452
Depreciation, etc.	$ 1,272	$ 1,270	$ 1,402	$ 1,394	$ 1,536	$ 1,518	$ 1,674	$ 1,642	$ 1,816	$ 1,766
Interest	288	288	288	288	288	288	288	288	288	288
Profit Before Taxes	$ 1,781	$ 1,404	$ 1,917	$ 1,640	$ 2,195	$ 1,882	$ 2,325	$ 2,137	$ 2,460	$ 2,398
Federal, State & Local Taxes	$ 804	$ 613	$ 820	$ 735	$ 1,012	$ 861	$ 1,077	$ 993	$ 1,142	$ 1,129
Net Income	$ 977	$ 791	$ 1,097	$ 905	$ 1,183	$ 1,021	$ 1,248	$ 1,144	$ 1,318	$ 1,269
Investment Credit	$ 122	$ 118	$ 125	$ 118	$ 129	$ 118	$ 132	$ 118	$ 137	$ 118

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EXHIBIT XVI

Council on Environmental Quality

IMPACT OF INFLATION ON STEEL INDUSTRY PROFITS
1972-1976
(Million of Dollars)

- Projected 1976 Industrywide Steel Shipments - 106 million tons
- 1972 Steel Product Capacity - 110 million tons

Income & Expense Resulting From Inflation

	1972	1973	1974	1975	1976	Total
Operating Revenues	$1,628	$2,603	$3,680	$4,606	$5,606	$18,123
Dividends Interest, etc.	18	29	40	51	61	199
Total	$1,646	$2,632	$3,720	$4,657	$5,667	$18,322
Employment Expenses	$ 878	$1,626	$2,306	$2,956	$3,642	$11,408
Materials & Services	389	721	1,083	1,481	1,913	5,587
Total	$1,267	$2,347	$3,389	$4,437	$5,555	$16,995
Gross Margin	$ 379	$ 285	$ 331	$ 220	$ 112	$ 1,327
Depreciation	2	8	18	32	50	110
Interest	-	-	--			
Pre-Tax Profit	$ 377	$ 277	$ 313	$ 188	$ 62	$ 1,217

The influence of expected productivity increases on pre-tax profits was determined as follows:

Year	Employment Expense No Increase in Productivity	Employment Expense With Productivity Increase	Net Pre-tax Profit
1972	$ 8,112	$(7,868)	$ 244
1973	8,425	(7,927)	498
1974	8,729	(7,967)	762
1975	9,042	(8,006)	1,036
1976	9,346	(8,027)	1,319
Total	$43,654	$39,795	$3,859

The fact that 93.4% of projected price increases were absorbed by cost increases also highlights the importance to future steel industry performance of growth without excessive inflation.

The following table illustrates the sensitivity of projected steel industry profits to price:

	(%) Price Increase			Revenue		
Year	As Projected*	@ 90%	@ 80%	As Projected*	@ 90%	@ 80%
1972	8.0	7.2	6.4	$ 22,207	$ 22,041	$ 21,877
1973	4.0	3.6	3.2	23,987	23,717	23,449
1974	4.0	3.6	3.2	25,846	25,457	25,072
1975	3.0	2.7	2.4	27,577	27,083	26,595
1976	3.0	2.7	2.4	29,357	28,749	28,148
		Total		$128,974	$127,047	$125,141
Decrease In Pre Tax Profit				N/A	$(1,927)	$(3,833)

* Source: Exhibit XIV (2)

In the table above, the rate of assumed annual price increases is reduced to 90% and 80% of that projected on Exhibit XIV (2). The impact

of these lower assumed price increases on projected pretax profits is significant. At the 90% level, projected pretax profits of $10.7 billion are reduced by $1.9 billion, a decrease of 17.8%, while at the 80% level, projected pretax profits are reduced by $3.8 billion, a drop of 35.5%. Similar sensitivity exists with respect to productivity as indicated by the table below:

	% Productivity Increases			Employment Expenses		
Year	As* Projected	@ 75%	@ 50%	As* Projected	@ 75%	@ 50%
1972	3.0	2.25	1.50	$ 8,746	$ 8,870	$ 8,931
1973	3.0	2.25	1.50	9,553	9,688	9,823
1974	3.0	2.25	1.50	10,273	10,484	10,706
1975	2.5	1.88	1.25	10,962	11,253	11,562
1976	2.5	1.88	1.25	11,669	12,052	12,458
				$51,203	$52,347	$53,840
Decrease In Pre Tax Profits				N/A	$ (1,144)	$ (2,637)

* Source: Exhibit XIV (2)

If productivity increases at 75% of the projected rate, projected pretax profits would decrease by $1.1 billion or 10.3%. If productivity were to increase at only 50% of the projected rate, projected pretax profits would decrease by $2.6 billion or 24.3%.

The above examples of the extreme sensitivity of steel industry profitability to price and productivity highlights the volatility of industry

performance in relation to underlying factors. It should be kept in mind also that similar volatility exists with respect to materials and services cost rates, capital equipment costs and volume. Thus, a significant adverse variance over time in one or more of the major factors underlying the projections contained in Exhibit XIV could seriously affect projected growth and profits.

3. STEEL PRICE INCREASES

Price quotations for finished steel rose very sharply during the postwar period. Between 1947 and 1971, the BLS index for finished steel prices (1967=100) rose from 45.5 to 123.0, or 171%, an average of 4.2% per year compounded. This increase has been much more rapid than the average for all industrial commodities, which increased only 61% over the same period.

The rate of increase in steel prices has not, however, been uniform. It was very rapid through the '50s, more than doubling between 1947 and 1959, leveling off during the early '60s, and resuming a faster increase after 1968. The intermediate period of relative stability may be attributed mainly to the 1959-61 recession and to "jawboning" pressure by the Kennedy and Johnson Administrations. While increasing foreign competition must have exerted some

restraining influence, this was probably reflected more in unpublished price concessions for some products than in the quoted prices on which the index is based.

In the past few years, the degree of "price leadership" in steel markets has noticeably decreased. In late 1968, sharp cuts in price quotations were announced by Bethelehem Steel, apparently in reprisal for unpublicized concessions by other producers. After several months, however, the market appeared to stabilize. In early 1972, U. S. Steel similarly announced some price reductions which were understood to be directed against concessions on quantity sales being offered by Inland Steel. Also, in early 1972, Bethlehem Steel announced a price freeze on its full line of rolled steel products until January 1, 1973. All other domestic steel producers followed suit. Looking ahead, the picture is unclear. Although prices are frozen for 1972, it may be assumed that the steel industry will make every effort to raise prices in the future to cover costs and also to improve profit margins. The principal constraints to be expected are continued government regulations in some form or other, and competitive considerations.

On the basis of the policies presently apparent, it is unlikely that the Price Commission, or any successor, will vigorously

oppose cost-related price increases, though widening of margins may be resisted. Steel price increases need not conflict with the Federal goal of holding the increase in the overall price level to about 2-1/2%, since industrial commodity prices have historically risen more rapidly than the general price level, and steel even more rapidly. Between 1947 and 1971, for example, the wholesale price of all commodities rose 49%, while industrials advanced 61%. In any event, and regardless of the overall impact, Federal price regulation has, and is likely in the future to take account of rising costs. It seems highly probable, moreover, that mandatory controls will not continue for more than a year or so, though some kind of informal or "jawboning" pressures may be maintained. A reasonable assumption, therefore, is that government intervention in whatever form will not operate so as to prevent cost increases from being reflected in prices.

As regards internal and interindustry competition, it is assumed that this is unlikely to exercise a major restraining influence, except possibly for a few products especially vulnerable to substitution.

The pressure of foreign competition may be considerably more serious. Its impact will depend in good part on whether the VRA will be effective. With the VRA, competitive price pressure is lessened,

and is likely to be limited to relatively special situations. In the absence of quantitative restrictions, import price competition may be expected to constitute an important constraint, often resulting in unpublicized concessions to important customers. The recent currency revaluations should lessen, but cannot be expected to eliminate this problem.

Steel price increases have been averaging 5.3% per year between 1967 and 1971. In 1971 alone, average prices were 7.6% higher than in 1970. The labor settlement of August 1970 increased costs significantly, especially for its first year; the increases scheduled for the last two years of the contract are more moderate.

Taking all these factors into account, steel price increases of the order of about 4% per year from 1973 to 1976 could prove attainable. For the purpose of this analysis, a range of 3 to 5% may represent the likely lower and upper limits of attainability.

4. PRODUCTIVITY

The principal factors affecting labor productivity are changing technology, capital investment, product mix, managerial and labor competence and efficiency, and the rate of capacity utilization. Technology in the steel industry has been steadily and even dramatically improving, but wide swings in demand and output have prevented

this from being reflected in a steady growth of labor productivity. As is evident from Exhibit XVII, following this page, declines in output (as measured by shipments of finished steel) have generally been accompanied by slumps in productivity, with the exception of 1971, and improvement has generally been substantial during periods of rising output. The pattern is not entirely uniform; the tendency to retain workers when a decline in demand was regarded as temporary, or to hold back on rehiring during the initial stages of rising demand obscures year-to-year comparisons. The pattern is also affected by problems encountered in breaking in new types of equipment.

The recent trend of productivity (output per man-hour) in the steel industry has been, on the whole, disappointing. Between 1957 and 1970, it improved only 14% according to BLS estimates, or only about 1% per year. During certain periods, however, the record was much better; between 1960 and 1966, for example, productivity improved over 25% or an average of 3.8% per annum.

Since 1966, except for a brief spurt in 1968, productivity has been flat, as has demand and output. If the next few years bear out the promise of vigorous growth of the general economy, bringing with it substantially higher demand for steel, significant productivity improvement may also be expected, especially as new and more

EXHIBIT XVII

Council on Environmental Quality

STEEL INDUSTRY PRODUCTIVITY
AND NET STEEL SHIPMENTS
1960-1971

Year	Productivity* Index (1967=100)	Percent Change	Net Steel Shipments (Million Tons)	Percent Change
1960	82.3	-6.0	71.1	+ 2.4
1961	84.9	+3.2	66.1	- 7.0
1962	89.2	+5.1	70.6	+ 6.8
1963	93.2	+4.5	75.6	+ 7.0
1964	97.2	+4.3	84.9	+12.3
1965	101.1	+4.0	92.7	+ 9.1
1966	103.2	+2.1	90.0	- 3.0
1967	100.0	-3.1	83.9	- 6.8
1968	104.2	+4.2	91.9	+ 9.1
1969	104.8	+0.7	93.9	+ 2.2
1970	101.7	-2.9	90.8	- 3.8
1971	105.0	+3.3	86.0**	- 6.0

* Source: Bureau of Labor Statistics
** Preliminary estimate

efficient facilities are completed and broken in, and older facilities retired. The highs of the 1960-66 period may not be repeated, but a rate of 3% of more should be entirely feasible, especially in the early years, 1972-1973.

5. CASH FLOW PROJECTIONS

Exhibit XVIII (1, 2, 3), following this page, contains steel industry cash flow projections. These projections are based on demand, capacity and profitability estimates discussed previously. Significant points highlighted by projections are as follows:

- Exhibit XVIII (1)

  With 1976 steel shipments projected at 100 million tons no significant capacity increases would be required from within the range of our estimates of current capacity. Over the period 1971-1976 cumulative cash available for pollution abatement related capital spending would be $2.2 billion.

- Exhibit XVIII (2)

  With 1976 steel shipments projected at 106 million tons, cash flow becomes sensitive to current capacity estimates and required peaking factors.

  - If current capacity is estimated at 110 million tons with an 8% peaking factor, cumulative cash available for investment in pollution abatement related projects over the six year period would be $818 million.

  - If a current capacity estimate of 110 million tons with a 4% peaking factor is used OR a

EXHIBIT XVIII(1)

Council on Environmental Quality

PROJECTED STEEL INDUSTRY CASH FLOW
1971-1976
(Millions of Dollars)

- Projected 1976 Industrywide Steel Shipments - 100 million tons
- 1972 Industry Steel Product Capacity - 107 million tons - 114 million tons

	1971	1972	1973	1974	1975	1976
Net Income	$ 578	$ 936	$1,020	$1,137	$1,184	$1,232
Depreciation	1,158	1,260	1,366	1,475	1,587	1,703
Other Non-Cash Expenses	57	66	70	75	79	83
Subtotal	$1,793	$2,262	$2,456	$2,687	$2,850	$3,018
Less:						
Dividends	$ 390	$ 400	$ 400	$ 400	$ 400	$ 400
Capital Expenditures	1,350	1,410	1,450	1,490	1,540	1,590
Increase in Working Capital	27	557	252	276	237	249
Subtotal	$1,767	$2,367	$2,102	$2,166	$2,177	$2,239
Cash Available For Investment Yearly	$ 26	($ 105)	$ 354	$ 521	$ 673	$ 779

EXHIBIT XVIII (2)

Council on Environmental Quality

PROJECTED STEEL INDUSTRY CASH FLOW
1971-1976
(Millions of Dollars)

- Projected 1976 Industrywide Steel Shipments - 106 million tons
- 1972 Industry Steel Product Capacity - 110 million tons with a Peaking Factor of 8%

	1971	1972	1973	1974	1975	1976
Net Income	$ 578	$ 977	$1,097	$1,183	$1,248	$1,318
Depreciation	1,158	1,272	1,402	1,536	1,674	1,816
Other Non-Cash Expenses	57	66	72	77	83	88
Subtotal	$1,793	$2,315	$2,571	$2,796	$3,005	$3,222
Dividends	$ 390	$ 400	$ 400	$ 400	$ 400	$ 400
Capital Expenditures	1,350	1,740	1,790	1,840	1,890	1,950
Increase in Working Capital	27	537	338	355	346	357
Subtotal	$1,767	$2,677	$2,528	$2,595	$2,636	$2,707
Cash Available for Investment - Yearly	$ 26	$ (336)	$ 43	$ 201	$ 369	$ 515

- Projected 1976 Industrywide Steel Shipments - 106 million tons
- 1972 Industrywide Steel Product Capacity 114 Million Tons with 8% Peaking Factor OR 110 Million Tons with 4% Peaking Factor

	1971	1972	1973	1974	1975	1976
Net Income	$ 578	$ 960	$1,079	$1,187	$1,266	$1,346
Depreciation	1,158	1,260	1,366	1,475	1,587	1,703
Other Non-Cash Expenses	57	66	72	77	83	88
Subtotal	$1,793	$2,286	$2,477	$2,739	$2,936	$3,137
Dividends	$ 390	$ 400	$ 400	$ 400	$ 400	$ 400
Capital Expenditures	1,350	1,410	1,450	1,490	1,540	1,590
Increase in Working Capital	27	537	338	355	346	357
Subtotal	$1,767	$2,347	$2,188	$2,245	$2,286	$2,347
Cash Available for Investment Yearly	$ 26	$ (61)	$ 289	$ 494	$ 650	$ 790

EXHIBIT XVIII (3)

Council on Environmental Quality

PROJECTED STEEL INDUSTRY CASH FLOW
1971-1976
(Millions of Dollars)

- Projected 1976 Industrywide Steel Shipments - 113 million tons
- 1972 Industry Steel Product Capacity - 110 million tons

	1971	1972	1973	1974	1975	1976
Net Income	$ 578	$1,083	$1,227	$1,402	$1,502	$1,610
Depreciation	1,158	1,300	1,486	1,678	1,875	2,078
Other Non-Cash Expenses	57	68	74	81	87	93
Subtotal	$1,793	$2,477	$2,787	$3,161	$3,464	$3,781
Dividends	$ 390	$ 400	$ 400	$ 400	$ 400	$ 400
Capital Expenditures	1,350	2,478	2,553	2,629	2,708	2,789
Increase in Working Capital	27	690	375	404	376	395
Subtotal	$1,767	$3,568	$3,328	$3,433	$3,484	$3,584
Cash Available for Investment Yearly	$ 26	$(1,091)	$ (541)	$ (272)	$ (20)	$ (197)

- Projected 1976 Industrywide Steel Shipments - 113 million tons
- 1972 Industry Steel Product Capacity - 107 million tons

	1971	1972	1973	1974	1975	1976
Net Income	$ 578	$1,097	$1,233	$1,398	$1,487	$1,585
Depreciation	1,158	1,310	1,517	1,731	1,950	2,176
Other Non-Cash Expenses	57	68	74	81	87	93
Subtotal	$1,793	$2,475	$2,764	$3,210	$3,524	$3,854
Dividends	$ 390	$ 400	$ 400	$ 400	$ 400	$ 400
Capital Expenditures	1,350	2,756	2,839	2,923	3,011	3,101
Increase in Working Capital	27	690	375	404	376	395
Subtotal	$1,767	$3,846	$3,614	$3,727	$3,787	$3,896
Cash Available for Investment Yearly	$ 26	$(1,371)	$ (850)	$ (517)	$ (263)	$ (42)

current capacity estimate of 114 million tons, regardless of peaking factor, cumulative cash available for pollution abatement related investment would be $2.2 billion.

Although the detailed computations have not been included with estimated current capacity at 107 million tons, cumulative cash available for investment in pollution abatement projects would range from $1.4 billion to approximately ($290) (negative) million, depending on the peaking requirements assumed.

Exhibit XVIII (3)

With 1976 steel shipments projected at 113 million tons, in most cases the steel industry would require significant amounts of outside capital funds for capacity expansion.

- With current steel capacity at 110 million tons and an 8% peaking factor, approximately $1.7 billion would be required from outside sources to expand capacity to required levels.

- With current steel capacity at 107 million tons and an 8% peaking factor, approximately $3.0 billion would be required from outside sources.

Using a 4% peaking factor (not shown in Exhibit), with current capacity at 107 million tons, $1.2 billion would be required from outside sources. At a current capacity level of 110 million tons a cumulative balance of approximately $100 million would be available for pollution abatement related investment.

A capacity level of 114 million tons would provide virtually a zero balance of cash available with an 8% peaking factor, which a cumulative funds availability for pollution abatement projects of $1.4 billion would result using a 4% peaking factor.

The conclusions to be drawn from a review of the cash flows discussed above are as follows:

- Potential steel shipments of 106 million tons by 1976 appear generally to be well within the internal financing capacilities of the steel industry (excluding consideration of pollution abatement costs).

- Steel shipments of 113 million tons would probably require significant outside financing, elimination of dividends or in some cases both. Only with the most favorable assumptions regarding capacity, peaking requirements and/or the cost per ton of additional capacity does it appear that this level of shipments would be attainable using internally generated funds. (Again, excluding consideration of pollution abatement costs.)

While, with economic recovery proceeding as forecasted, the potential for steel shipments of 113 million tons by 1976 may be good on the demand side, it appears unlikely, in view of the above, that industry capacity will be increased to a level sufficient to meet that demand. This conclusion is based on the following factors:

- Steel producers are basing current expansion plans on estimated 1976 shipments of 106 million tons. While shipments by 1976 of 113 million tons are possible, the risk of expanding capacity and facing a significant demand short fall will probably weigh most heavily in the capital budgeting process.

- Because of the above risk and poor recent performance, it is unlikely that producers would further decrease dividends to expand capacity.

- While subsequent analysis suggests that the raising of equity capital in the market is theoretically feasible, given the potential returns from such

investment, this course would not be practical because of the risk factors identified above.

- The current financial condition of the industry would make it unlikely that managers would seriously consider debt, again because of risk.

The above comments reflect the conservatism likely to be applied by steel industry executives in planning for the period 1972 - 1976. Because of the lead time required to evaluate, plan for, and physically accomplish capacity expansion, it is unlikely that decisions made in 1972 could be altered in time to significantly change the picture by 1976, even if executives by 1973 - 1974 were fully confident of a potential 1976 market of 113 million tons or more.

For the above reasons, the most probable level of shipments by 1976 should be in the 100-106 million ton range. The limiting factor in this conclusion is capacity rather than demand.

6. FINANCING POLLUTION ABATEMENT CAPITAL EXPENDITURES

Exhibit XIX (1, 2, 3, 4) following this page, shows the effect of financing pollution abatement capital expenditures through a combination of internal cash flow and long-term debt. The pollution abatement capital expenditure requirements shown reflect the high

EXHIBIT XIX(1)

Council On Environmental Quality

FINANCING POLLUTION ABATEMENT CAPITAL EXPENDITURES
1972-1976
(Millions of Dollars)

Projected 1976 Industrywide Steel Shipments - 100 million tons
1972 Industry Steel Product Capacity - 107 - 114 million tons
Peaking Factor 8%

	YEAR				
	1972	1973	1974	1975	1976
Cash Available Internally	$ (79)	$ 354	$ 521	$ 673	$ 779
Investment Required	338	456	997	1,136	520
Additional Cash Required	$ 417	$ 102	$ 476	$ 463	$ (259)
Depreciation on Abatement Equipment	21	51	136	233	276
Borrowing Required	$ 396	$ 51	$ 340	$ 230	$ (535)
Shareholder's Equity (Beginning of Year)	$13,045	$13,581	$14,201	$14,938	$15,722
Earnings Retained	536	620	737	784	832
Shareholder's Equity (Year End)	$13,581	$14,201	$14,938	$15,722	$16,554
Long Term Debt	$ 5,758	$ 5,809	$ 6,149	$ 6,379	$ 5,844
% Debt to Equity	42.3	40.9	41.1	40.6	35.3

EXHIBIT XIX (2)

Council on Environmental Quality

FINANCING POLLUTION ABATEMENT CAPITAL EXPENDITURES
1972-1976
(Millions of Dollars)

Projected 1976 Industrywide Steel Shipments - 100 million tons
1972 Industry Steel Product Capacity - 107-114 million tons
Peaking Factor 8%
Accelerated Capital Expenditures - $2.75 billion

	YEAR				
	1972	1973	1974	1975	1976
Cash Available Internally	$ (79)	$ 354	$ 521	$ 673	$ 779
Investment Required	338	456	1,830	1,969	1,353
Additional Cash Required	$ 417	$ 102	$1,309	$1,296	$ 574
Depreciation on Abatement Equipment & Capacity Replaced	21	51	198	357	462
Borrowing Required	$ 396	$ 51	$1,111	$ 939	$ 112
Additional Earnings Retained	-0-	-0-	400	400	-0-
Net Borrowing Required	$ 396	$ 51	$ 711	$ 539	$ 112
Shareholder's Equity (Beginning of Year)	$13,045	$13,581	$14,201	$15,338	$16,522
Earnings Retained	676	620	1,137	1,184	832
Shareholder's Equity (Year End)	$13,581	$14,201	$15,338	$16,522	$17,354
Long Term Debt	$ 5,758	$ 5,809	$ 6,520	$ 7,059	$ 7,171
% Debt to Equity	42.3	40.9	42.5	42.7	41.3

EXHIBIT XIX(3)

Council on Environmental Quality

FINANCING POLLUTION ABATEMENT CAPITAL EXPENDITURES
1972-1976
(Millions of Dollars)

Projected 1976 Industrywide Steel Shipments - 106 million tons
1972 Industry Steel Product Capacity - 110 million tons
Peaking Factor 8%

	YEAR				
	1972	1973	1974	1975	1976
Cash Available Internally	$ (310)	$ 43	$ 201	$ 369	$ 515
Investment Required	338	456	997	1,136	520
Additional Cash Required	$ 648	$ 413	$ 776	$ 767	$ 5
Depreciation on Abatement Equipment	21	51	136	233	276
Borrowing Required	$ 627	$ 362	$ 640	$ 534	$ 271
Additional Earnings Retained	300	-0-	200	-0-	-0-
Net Borrowing Required	$ 327	$ 362	$ 440	$ 534	$ (271)
Shareholder Equity (Beginning of Year)	$13,045	$13,922	$14,619	$15,602	$16,450
Earnings Retained	877	697	983	848	944
Shareholder Equity (Year End)	$13,922	$14,619	$15,602	$16,450	$17,394
Long Term Debt	$ 5,689	$ 6,051	$ 6,491	$ 7,025	$ 6,754
% Debt to Equity	40.9	41.4	41.6	42.7	38.8

EXHIBIT XIX (4)

Council on Environmental Quality

FINANCING POLLUTION ABATEMENT CAPITAL EXPENDITURES
1972-1976
(Millions of Dollars)

Projected 1976 Industrywide Steel Shipments - 106 million tons
1972 Industry Steel Product Capacity - 110 million tons
Peaking Factor - 8%
Accelerated Capital Expenditures - $2.75 billion

	YEAR				
	1972	1973	1974	1975	1976
Cash Available Internally	($ 310)	$ 43	$ 201	$ 369	$ 515
Investment Required	338	456	1,830	1,969	1,353
Additional Cash Required	648	413	1,629	1,600	838
Depreciation on Abatement Equipment	21	51	198	357	462
Borrowing Required	627	362	1,431	1,243	376
Additional Earnings Retained	400	362	400	400	376
Net Borrowing Required	227	- 0 -	1,071	843	- 0 -
Shareholder Equity (Beginning of Year)	$13,045	$14,022	$15,081	$16,264	$17,512
Earnings Retained	977	1,059	1,183	1,248	1,320
Shareholder Equity (Year End)	$14,022	$15,081	$16,264	$17,512	$18,832
Long Term Debt	$ 5,589	$ 5,589	$ 6,620	$ 7,463	$ 7,463
% Debt to Equity	39.9	37.1	40.7	42.6	39.6

estimates supplied by CEQ. The range of estimated capital requirements is $2.4 billion - $3.5 billion. The impacts indicated are as follows:

- Exhibit XIX (1)

  With steel shipments by 1976 of 100 million tons and accelerated capital expenditures at the zero level, financing pollution abatement capital expenditures, after provision for normal facilities replacement and working capital would require new long term borrowings of approximately $600 million. This assumes that dividend payouts remain at 1971 dollar levels and that all funds available internally after provision for normal facilities replacement and working capital are used for pollution abatement.

  Given that steel industry growth and profits will equal or come close to levels projected on Exhibit XIX (1), financing pollution abatement capital expenditures should prove feasible assuming such expenditures are as high as $3.5 billion.

  No provision for repayment of projected new borrowings has been made as it is assumed that such debt would be rolled over at maturity.

- Exhibit XIX (2)

  With steel shipments by 1976 of 100 million tons, pollution abatement capital expenditures of $3.5 billion and accelerated capital expenditures of $2.75 billion, the steel industry would be required to raise approximately $800 million dollars in addition to that potentially available through new borrowing and retention of earnings at levels indicated on Exhibit XIX (1). *This analysis is sensitive to both the cost of

* Limitations on new borrowings (Exhibit XIX 1-4) are based on the assumption that debt may not significantly exceed 40% of shareholders equity in any given year. This ratio which approximates current debt/equity relationships is significantly higher than historical levels and may be assumed to approximate a debt ceiling.

pollution abatement and the accelerated capital expenditures required. For example, if pollution abatement capital expenditure requirements were $2.4 billion, the figure quoted above would be reduced from $800 million to $400 million.

Exhibit XIX (3)

With steel shipments by 1976 of 106 million tons and present steel product capacity of 110 million tons, financing pollution abatement capital expenditures would require $500 million in addition to that available through new borrowings and retention of earnings at levels indicated on Exhibit XIX (1). This assumes that there are no accelerated capital expenditures.

If one or more of the following conditions were present, the $500 million figure quoted above would be reduced to zero:

- Pollution abatement capital expenditures requirements of $2.4 billion

- Current steel product capacity of 114 million tons

- Required peaking factors of 4% with current steel product capacity of 110 million tons

At a current steel product capacity level of 107 million tons, depending on the peaking factor used (4% - 8%) additional funding requirements as defined above could range from zero to $1.1 billion

Exhibit XIX (4)

With steel shipments by 1976 of 106 million tons and present steel product capacity of 110 million tons, financing total capital expenditures with the need to spend $2.75 billion for accelerated replacement of plant and equipment would require raising approximately $2 billion in addition to that available through new borrowing and earnings retention at levels identical on Exhibit XIX (1).

The above analysis is based on estimated maximum feasible new borrowings of $1.9 billion. To raise such an amount, steel producers will have to satisfy lender credit requirements. In analyzing risk potential lenders normally view the ability of a borrower to maintain dividend payments as a factor indicating the ability of the borrower to meet debt service requirements as principal and interest payments on debt must be met before dividends can be paid. Witn this "reserve" debt service capacity eliminated, say by increasing earnings retention rates to obtain the $2 billion additional funding discussed above, the ability of the steel industry to raise $1.9 billion through new borrowings would be significantly impaired.

If one or more of the following conditions were to be present, additional funding requirements would be reduced to $800 million as opposed to $2 billion.

- Current steel product capacity of 114 million tons

- Required peaking factor of 4% with current capacity of 110 million tons

With additional funding requirements reduced from $2 billion to $800 million, the factors discussed above which limit the use of additional earnings retention to raise the required funds could remain operable although the extent to which they would impact the use of additional retained earnings is uncertain.

If pollution abatement capital requirements were $2.4 billion as opposed to $3.5 billion and one or both of the above conditions were present, additional funding requirements would be reduced from $2 billion to zero.

As discussed previously, the most likely range of steel output by 1976 is 100-106 million tons. As indicated by the pollution abatement financing alternatives illustrated in Exhibit XIX (1-4), the attainment of a productive level of 106 million tons (the high end of the range) is dependent on several factors which are characterized by significant uncertainty. These factors are as follows:

- Pollution abatement capital requirements
- Current industry production capacity
- The cost of additional capacity
- Reserve capacity required for peak demand periods
- Accelerated capital expenditure requirements

The impact of pollution abatement costs on industry growth, as a result of the above uncertainties, cannot be pinpointed. Based on preceding analysis, however, the following conclusions appear warranted:

- A minimum growth in steel industry shipments to 100 million tons by 1976 can reasonably be expected. To fund pollution abatement capital expenditures steel producers will be required to do the following:
  - Obtain new borrowings at a rate which will keep the industry at or near its feasible borrowing limits
  - Apply all available internal funds to pollution abatement after provision for dividends at 1971 dollar levels, normal capital expenditures, and working capital

- Subject to the potential burden of accelerated capital expenditures, it appears that financing pollution abatement capital expenditures should in the main be possible, given that industry profit performance is as projected.

. Growth to a 1976 shipment level of 106 million tons in the face of pollution abatement capital requirements is dependent on the behavior of five variables (see above) characterized by uncertainty. Thus attainment of shipment levels of 106 million tons is possible but by no means a certainty.

. Growth to 1976 shipment levels of 113 million tons may be ruled out on the basis of the inability of the industry to finance the necessary investment. In this case, however, pollution abatement costs are not the controlling factor.

7. RAISING EQUITY CAPITAL

In the preceding section, the raising of equity capital in external markets was not considered. As further analysis will indicate, raising equity capital would be theoretically possible on a "textbook" basis, but does not warrant serious consideration, at least at this point in time, as a practical matter.

(1) Required Rate of Return on Investment

The required rate of return on investment for the steel industry, or any industry for that matter, can be expressed in terms of the level of earnings required to maintain the market price of stockholder shares and their dividend returns.

Equity capital and debt capital have different costs. Debt is less costly, principally because interest payments (the cost of debt) are tax deductable while dividends (the cost of equity capital) are not.

While dividends represent the true cost of equity capital, as a practical matter required rates of return on equity capital will be computed in terms of earnings. This practice is generally accepted in the financial community.

The estimated required rate of return on new equity to the steel industry is 9.8% per year. This estimate was arrived at as follows:

- Estimated average earnings for the period 1972 - 1976 were as forecast on Exhibit XIV (1).
- Average Price Earnings Ratio for the period was estimated at 11.4-1
- Revenue to firms from new shares issued was estimated at 90% of market price, reflecting issue price and costs of issuing stock.
- Using above variables the required rate of return was computed using the following formulas:

  E (Earnings Per Share) = Average Net Earnings

  P (Price Per Share) = Average Net Earnings x 11.4

R (Revenue From New Shares = 0.9P

ROI (Required Rate of Return) = $\frac{E}{.9P}$

ROI = $\frac{1}{.9(114)}$ = $\frac{1}{10.26}$

ROI = 9.8%

Required rate of return on debt capital is a function of interest cost. The estimate of the cost of debt at 4.07% (after tax) is based on an assumed interest rate of 8% and an applicable tax rate of 50%. The cost estimated after tax is slightly higher than 4% reflecting the amortization of bond discount and debt issue costs.

To develop an average rate of return which would reflect both the debt and the equity in the steel industry capital structure a constant steel industry capital structure over the period 1972 - 1976 was assumed composed of 73% equity and 27% debt. Equity was valued at estimated market value as opposed to book value. The weighted average required return at 8.25% was computed as follows:

	Required Return	Weight	Weighted Average
Debt	4.07%	.27	1.10%
Equity	9.80%	.73	7.15%
Weighted Average Return			8.25%

The weighted average rate of return shown above (also called "Weighted Average Cost of Capital") was based on a relatively unsophisticated approach to determining required rates of return. However, it is adequate for purposes of this study. The major factor which hasn't been considered in the estimate is risk which was assumed constant. This will be discussed in more detail below.

(2) Expected Rates of Return On Capacity Expansion

In order to justify capacity expansion, the investment required should generate a return of 8.25% after all costs, including pollution abatement costs. Using the Net Present Value of Cash Flow associated with incremental investment in new capacity, the manufacturing cost efficiencies required to justify such investment were computed:

Incremental Capacity	Manufacturing Cost Per Ton Savings Required
1st million tons	- 0 -
2nd million tons	1.2%
3rd million tons	5.6%
4th million tons	10.7%
5th million tons	15.9%

The assumptions used in preparing this analysis were as follows:

- Capital Investment
  - As indicated on the sliding scale inflated to average 1975 dollars
  - For pollution abatement - 6.4% of basic capacity investment
- Income and Cost
  - Price per ton - 1976 prices as indicated on Exhibit XIV
  - Base manufacturing cost per ton - as indicated on Exhibit XIV (1)
  - Depreciation - double declining balance method over fourteen years
  - Tax rate - 50%

The manufacturing cost savings indicated above represent the difference between average industry manufacturing costs for 1976 and costs required to generate a return of 8.25% on capacity expansion. The cost savings indicated should be within the the limits of what might be expected from the installation of new efficient capacity. Thus, on the basis of a theoretical analysis it would appear that raising new debt and equity in the market place would be justified for capacity expansion.

(3) Some Practical Considerations

The above analysis has assumed that returns as computed are certain, however the steel industry is a cyclical industry

which moves with the economy so the risk of economic downturn must be weighed against the possible returns from capcity expansion. At this point in time, it is likely that the market and industry executives would weigh this risk very heavily and set return requirements significantly above the 8.25% based on computations which do not consider risk. Over the long term the prospects of a cyclical downturn in the economy and consequent declines in steel industry profitability are very real. On this basis, it is probable a fundamental change in the economy would be required before any significant equity capital would be available to the steel industry. Generally speaking, firms raising significant amounts of equity capital in the market place are those firms which have good growth and profit prospects which are relatively independent of cyclical movements in the economy.

8. COVERING POLLUTION ABATEMENT ANNUAL COSTS

Exhibit XX, following this page, shows pollution abatement annual costs (operating costs plus debt service) assuming that the high estimates supplied by approximate real costs. The costs have been computed under two alternative assumptions:

- That steel shipments by 1976 will be 100 million tons and that capacity in 1972 is 110 million tons
- That steel shipments by 1976 will be 106 million tons and that capacity in 1972 is 110 million tons

Interest costs as computed in estimates supplied by CEQ have been adjusted as follows:

- The assumed interest rate has been reduced from 10% to 8%
- The amount of borrowing assumed is as indicated on Exhibit XIX

Exhibit XXI, following Exhibit XX, shows estimated annual price increases to fully cover pollution abatement costs, as well as other cost increases. Average annual price increases, based on an estimated 1970 price of $200 per ton for the period 1973-1976 are estimated to be from 4.2% or 4.3%. Such price increases fall within the range (3%-5% per year) which appears feasible.

EXHIBIT XX

Council on Environmental Quality

AIR AND WATER POLLUTION ABATEMENT
ANNUAL COSTS
1972-1976
(Millions of Dollars)

	YEAR				
	1972	1973	1974	1975	1976
Operations Maintenance and Depreciation	$ 68	$ 168	$ 437	$ 661	$ 800
Investment Credit	(24)	(32)	(70)	(80)	(36)
Subtotal	$ 44	$ 136	$ 367	$ 581	$ 764
Inflated @ 3% per year	$ 45	$ 144	$ 401	$ 654	$ 886
Cost Per Ton Assuming 1976 Steel Shipments of 100 Million Tons and 1972 Capacity of 110 Million Tons					
Subtotal	$ 45	$ 144	$ 401	$ 654	$ 886
Interest @ 8%	16	34	50	73	61
Total Cost	$ 61	$ 178	$ 451	$ 727	$ 947
Net Steel Shipments (Million Tons)	92	94	96	98	100
Cost Per Ton ($)	$0.66	$1.89	$4.70	$7.42	$9.47
Cost Per Ton Assuming 1976 Steel Shipments of 106 Million Tons and 1972 Capacity of 110 Million Tons					
Subtotal	$ 45	$ 144	$ 401	$ 654	$ 886
Interest @ 8%	13	40	72	107	111
Total Cost	$ 58	$ 184	$ 473	$ 761	$ 997
Net Steel Shipments (Million Tons)	92	96	99	103	106
Cost Per Ton	$0.63	$1.92	$4.78	$7.39	$9.41

EXHIBIT XXI

Council on Environmental Quality

STEEL PRICE INCREASES REQUIRED TO COVER POLLUTION ABATEMENT COSTS 1972-1976

Year	Price Per Ton of Steel	Pollution Abatement Cost/Ton		Total Price/ Ton of Steel	
		100 M. T.	106 M. T.	100 M. T.	106 M. T.
1972	$230.69	$0.66	$0.63	$231.35	$231.32
1973	239.92	1.89	1.92	241.81	241.84
1974	249.51	4.70	4.78	254.21	254.29
1975	257.00	7.42	7.39	264.42	264.39
1976	264.71	9.47	9.41	274.18	274.12

	Percent Price Increase	
	100 M. T.	106 M. T.
1972	8.3	8.3
1973	4.5	4.5
1974	5.1	5.1
1975	4.0	3.9
1976	3.7	3.6
Average Annual Price * Inc. 1973-76	4.3%	4.2%

* Average compound annual price increase

9. ALTERNATIVE MEANS OF FINANCING POLLUTION ABATEMENT

Because it is likely that some firms will have difficulty in meeting pollution abatement requirements by 1976, a number of alternative means of financing the necessary expenditure have been identified. Since for some individual companies, financing pollution abatement costs clearly will be difficult, each of these alternatives will require careful study reflecting each particular situation.

(1) Dividends

Historically, the steel industry has paid out roughly 50% of its net earnings in dividends. Steel stocks are considered to be income producers and, hence, their value is closely tied to anticipated dividends. In our analysis, we have postulated dividends at dollar levels of 1971. However, since we postulate earnings growth, the ratio of dividends to earnings is reduced to an average payout ranging from approximately 40% to 30% during the period 1972 - 1976 (Exhibit XIV-2). Thus a significant share of the cost of pollution abatement would, in this case, be borne by steel industry stockholders.

Firms which can raise capital in no other way than reduced dividends place a two-fold burden on their stockholders.

- A reduction in dividend income
- A probable reduction in the market value of equity (stocks)

As indicated previously, dividend reductions can also significantly limit the ability of a producer to require capital through debt.

(2) Industrial Revenue Bonds

Industrial revenue bonds which can be used for pollution abatement have two apparently attractive features:

- Low interest rates (tax free)
- Not shown on the balance sheet as long-term debt

While the low interest rate is a very attractive feature, industrial revenue bonds are debt, whether they appear on the balance sheet or not. The feasibility of this financing vehicle is still tied to the ability of the ultimate borrower to make payment when due. Consequently, while this financing method is attractive and could be of assistance to firms marginally eligible for the corporate bond market, it may not be a feasible method for a firm in financial difficulty. At any rate, it is quite likely that industrial revenue bonds would prove highly useful for some firms in some locations. It is not possible to be more specific without an analysis of each unique situation.

(3) Guaranteed Loans

Some form of Federal loan guarantee could be of assistance to weaker firms in obtaining needed capital. Such a procedure would likely require the assent of the banks holding borrower notes and of corporate bond holders.

(4) Tax Credits

Tax credits for pollution abatement would provide one means of immediate financing.

(5) Direct Government Support

Among the possible forms of direct government support are grants, loans, and interest subsidies. Any form of direct support should be selectively considered on the basis of regional and other public policy considerations.

(6) Extend the 1976 Deadline

On a selective basis to deal with hardship cases, the 1976 deadline for meeting pollution abatement requirements could be relaxed. This procedure might be of particular assistance in solving the problem of accelerated capital expenditures.

Of the financing vehicles we have evaluated briefly above, it appears that each might prove to be of some assistance to firms having difficulty meeting pollution abatement requirements, assuming that such vehicles as loan guarantees and tax credits are politically feasible. The preference for a particular method would depend on the individual circumstances involved.

* * * *

Chapter VI discusses the potential regional impact of pollution abatement costs.

VI. POTENTIAL REGIONAL EMPLOYMENT IMPACT

1. POTENTIAL NATIONWIDE IMPACT

During the period 1965-1970, steel industry average employment has declined steadily from 459 thousand workers to 403 thousand. This decline continued even during the peak production years of 1968-1969. The cause of this drop in employment was a combination of lagging demand with some increases in productivity. As a result of the decrease in steel shipments during 1971, average employment decreased further. Given the increase in shipments that is projected for the period 1972-1976, average steel industry employment, on a nationwide basis, should increase in the short run, in spite of pollution abatement costs. The factors controlling employment in the long run will be the level of output achieved and the rate of productivity growth achieved. It should be noted, however, that growth may be impacted adversely if significant accelerated capital expenditures are required as a result of pollution abatement regulations.

2. POTENTIAL LOCAL IMPACTS

Pollution abatement costs may result in the closing of older facilities which cannot be cleaned up economically. It must be pointed out however that it is very difficult to identify pollution abatement as a sole causative factor in such shutdowns. Marginal facilities are those which would normally be likely candidates for modernication or replacement. If a marginal facility is replaced by another facility, in another location, then it is likely that factors other than pollution abatement, such as access to markets or raw material would control the decision to relocate. In a situation where a company curtails production at a particular facility because of pollution abatement, and does not replace the capacity thus lost in another location, it could be said that local employment losses would be caused by pollution abatement. Local employment losses of this type due to inability of producers to replace uneconomical facilities (the Accelerated Capital Expenditure problem) may occur.

Given that the ability to meet pollution abatement costs and expand capacity is probably not equally distributed amont steel industry producers, a possible result of pollution abatement costs would be a loss of market share for some firms, offset by market share gains by other firms. This type of situation could, of course, also lead to

local employment displacement, offset on a nationwide basis by industry employment gains in other locations.

It is not possible and within the scope of our work to identify specific companies or specific facilities which would be shut down or contracted as a result of pollution abatement costs. To do so would require a detailed financial analysis of each company coupled with an indepth facility-by-facility review of current and future cost and project potential.